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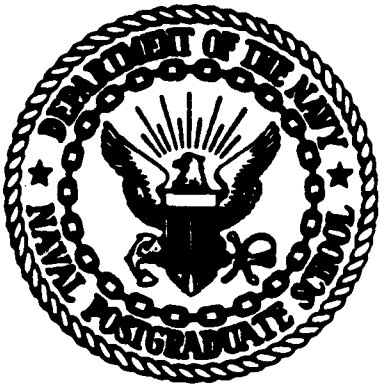

THESIS

COST EFFECTIVENESS ANALYSIS OF HOMEPORTING
AN AIRCRAFT CARRIER IN THE MEDITERRANEAN SEA

by

Michael J. Worley
and
William T. Minges, III

September 1981

Thesis Advisor: Robert Bobulinski

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Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD A110544 / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Cost Effectiveness Analysis of Homeporting an Aircraft Carrier in the Mediterranean Sea	5. TYPE OF REPORT & PERIOD COVERED Master's Thesis September 1981
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Michael J. Worley and William T. Minges, III	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Postgraduate School Monterey, California 93940	12. REPORT DATE September 1981
	13. NUMBER OF PAGES 161
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report)
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release, distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Cost model, cost effectiveness, homeporting, deployment, aircraft carrier.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

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S/N 0102-014-6601

Unclassified
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homeporting overseas for any military unit, is used to perform a differential cost analysis on each alternative. These costs are projected over a ten year period and discounted back to present value. Due to the high cost of dependent travel, and transportation of household goods and privately owned vehicles (POV), the present deployment alternative appears best from a strictly financial viewpoint except when the value of the above cost elements are kept to a minimum. However, the possibilities of limiting dependent travel and extending tour length, and non-quantifiable factors such as increased retention could shift the recommendation in favor of homeporting.

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Cost Effectiveness Analysis of Homeporting an Aircraft Carrier in the Mediterranean Sea

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requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
September 1981

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ABSTRACT

This analysis examines the cost effectiveness of two alternative approaches to providing United States Naval power projection to the Mediterranean Sea. The two alternatives are deploying an aircraft carrier from Norfolk, Virginia, which is the present posture, and homeporting an aircraft carrier in one of two overseas ports--Rota, Spain or Naples, Italy. A cost model, which the authors believe is appropriate for comparing the costs of deployment versus the costs of homeporting overseas for any military unit, is used to perform a differential cost analysis on each alternative. These costs are projected over a ten year period and discounted back to present value. Due to the high cost of dependent travel, and transportation of household goods and privately owned vehicles (POV), the present deployment alternative appears best from a strictly financial viewpoint except when the value of the above cost elements are kept to a minimum. However, the possibilities of limiting dependent travel and extending tour length, and nonquantifiable factors such as increased retention could shift the recommendation in favor of homeporting.

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I. INTRODUCTION

A. GENERAL INFORMATION

The United States has maintained a permanent military presence overseas since World War II. Although ground forces have been the major component of that presence in Central Europe and Korea, military presence outside these areas has been largely provided for by the U. S. Navy (USN). The USN has been involved in activities ranging from port calls and goodwill visits to deterring military aggression, i.e., threatening that force would be applied rapidly if such aggression materialized [Ref. 1].

The U.S. overseas naval posture has emphasized the use of task forces centered around the aircraft carrier. The aircraft carrier, through its air wing, constitutes a large aggregation of firepower which combines peacetime presence and world crisis control with the capability to move immediately into wartime power projection [Ref. 2]. This posture currently is maintained by six to nine month deployments of aircraft carriers from homeports in the U.S. to the Western Pacific, North Atlantic, Indian Ocean, and the Mediterranean Sea. The exception to this "rule" is the homeporting of the aircraft carrier USS Midway (CV-41) in Yokosuka, Japan.

Besides maintaining a significant presence in the Western Pacific and the Indian Oceans, the USN maintains an equal presence in the Mediterranean Sea. There, the USN mission is to reassure southern NATO allies, as well as Israel and moderate Arab States, of U.S. support in either a NATO war or a non-NATO Middle East crisis [Ref. 3].

Maintaining this presence in the Mediterranean Sea through the deployment of aircraft carriers has called for a significant dedication of resources by the Navy. As will be explained in Chapter II, the USN attempted to homeport an aircraft carrier in Athens, Greece in 1973 as a measure to conserve resources [Ref. 4]. However, in 1974 the Cyprus crisis caused political ties between the U.S. and Greece to become strained. Subsequently, Greece withdrew its offer to allow a U.S. aircraft carrier to be homeported in Athens. To date the U.S. has made no other attempt to homeport an aircraft carrier in the Mediterranean.

By trying to meet its worldwide commitment as previously described, the USN has stretched thin its aircraft carrier fleet. This has been demonstrated graphically since the USN has maintained a presence in the Indian Ocean. Deployments are closer to nine months in length than to the USN ideal of six months, and at times the number of operational aircraft carriers overseas has dropped below the number normally employed as the minimum level of naval presence [Ref. 5].

Although there are many alternatives available to correct the disparity between the size of the aircraft carrier fleet and the USN's overseas force requirements, it is the authors' belief that the most timely and financially viable alternative is overseas homeporting [Ref. 6]. This alternative is appealing because it does not require huge outlays for acquisition of new aircraft carriers and new aircraft, nor does it place new manpower demands on an already undermanned fleet [Ref. 7].

B. OBJECTIVE

The current USN policy of deploying aircraft carriers to the Mediterranean on a six to nine month turnaround basis entails certain recurring costs. If an aircraft carrier were to be homeported in the same area, much of the recurring costs would be reduced or eliminated, and certain one-time costs would be incurred.

The objective of this thesis is to construct a cost model that will compare the costs of deployment against the costs of homeporting to determine which is the most cost effective. The intent of the authors is to provide a means of comparison that is based on a macro viewpoint, i.e., provide a model which will incorporate the major financial factors that would influence a decision to homeport overseas versus deploying overseas.

C. METHODOLOGY

Department of Defense Instruction 7041.3, "Economic Analysis and Program Evaluation for Resource Management", Appendix A, was used as a guide for building the cost model and assessing the cost differential of alternative methods of force projection. Data were obtained from library searches, government documents, written correspondence, personal interviews, and the USN line officer experience and expertise of both authors. It was the authors' intent to examine the alternatives within a financial context, and with only minimal regard for political feasibility. Therefore, the end product of this thesis is a cost model with potential for application in any environment rather than a politico-economic model.

D. THESIS ORGANIZATION

Chapter I provides the reader with a recent history and the implications of the USN overseas presence, and the authors' objectives and methodology.

Chapter II discusses the role of the aircraft carrier in projection of naval force in the Mediterranean Sea, and the attempt to homeport an aircraft carrier in Athens, Greece.

Chapter III presents a model for determining the costs of deploying both an aircraft carrier and its air wing.

Chapter IV uses the model developed in Chapter III to determine the cost of deploying an aircraft carrier and its air wing.

Chapter V develops a model for determining the costs of homeporting an aircraft carrier and its air wing overseas.

Chapter VI is an analysis of homeporting in Rota, Spain.

Chapter VII is an analysis of homeporting in Naples, Italy.

Chapter VIII discusses nonquantifiable and uncertainty factors that have significant impact on the homeporting alternative. These factors include retention, training, and political implications.

Chapter IX integrates all previously discussed information to determine the cost effectiveness of homeporting overseas. This chapter also includes recommendations on the application of the cost model and recommendations for further study.

II. BACKGROUND--HOMEPORTING IN THE MEDITERRANEAN

A. INTRODUCTION

This chapter provides the reader with background information on the role of the USN aircraft carriers in the Mediterranean Sea, including the relationship to the North Atlantic Treaty Organization (NATO) and non-NATO commitments. Also discussed are the homeporting requirements established by the USN for the 1973 attempt to homeport an aircraft carrier in Athens, Greece. The reader then is acquainted with some of the competing alternatives to overseas homeporting.

In the following section, the authors intend to show that the mission of the USN Sixth Fleet revolves around the role of the aircraft carrier.

In section C of this Chapter, the authors examine the attempt to homeport an aircraft carrier in Athens to establish the baseline support and logistical requirements for the homeporting alternative.

Section D presents competing alternatives to overseas homeporting, and argues that the most viable short-run method to relieve an overtaxed carrier fleet is overseas homeporting.

Finally, section E discusses the authors' concept of a cost model, including basic assumptions and definitions.

B. MISSION OF THE SIXTH FLEET

The Sixth Fleet is responsible for both NATO and non-NATO missions in the Mediterranean Sea. The NATO missions, which led to the establishment of the Sixth Fleet 32 years ago, are keyed toward maintaining the confidence of U.S. Allies (including Italy, Greece, and Turkey)

that U.S. Forces would be committed to protecting the southern flank of NATO in the event of a NATO/Warsaw Pact conflict [Ref. 8]. By treaty, the U.S. is required to provide two aircraft carriers to NATO within 48 hours of the beginning of a conflict in Europe [Ref. 9]. The role of the aircraft carriers in the event of an European conflict would be to project U.S. air power for fleet defense, and for tactical air support to Marine Forces. The main thrust of this defensive action is to assist Turkey in defending the Turkish Straits, thereby denying the Soviet Navy the use of the Mediterranean Sea, [Ref. 10].

Central to the non-NATO mission is the maintenance of stability between Israel and the Arab States. This importance stems from the fact that Western Europe and the U.S. are both dependent, in varying degrees, on Arab oil. By promoting peace in the Middle East, the U.S. can help ensure uninterrupted oil flow from these Arab nations. In addition to protecting oil interests, the Sixth Fleet has the continuing task of maintaining the balance of sea power in the Mediterranean Sea against an evergrowing Soviet Mediterranean Squadron, [Ref. 11 and Ref. 12]. This balance of power is particularly important in the Middle East where the Arab States are roughly half pro-American and half pro-Soviet. Over the past several years, the Middle East has been wracked by conflict, and the Sixth Fleet has--through its aircraft carriers--been a major deterrent to Soviet intervention in that area, [Ref. 13].

C. THE ATTEMPT TO HOMEPORT IN ATHENS

In 1972 the USN embarked upon a program to homeport six destroyers, and in 1973 an aircraft carrier in Athens, Greece. Athens was chosen over many other Mediterranean ports after lengthy and detailed studies. The USN listed seven criteria (see Exhibit II-1) that had to be considered [Ref. 14]: strategic location, adequate harbor, jet-capable airfield, adequate ship repair facilities, adequate urban support, local acceptability, and keeping the destroyers and the aircraft carrier in the same port. The seven criteria listed by the USN are explained further to provide the reader with an understanding of exactly what attributes were necessary to meet the minimum requirements of the USN.

As stated earlier, the main defensive mission of the Sixth Fleet is to assist Turkey in defending the Turkish Straits, the Bosporus, and the Dardanelles in the event of a NATO/Warsaw Pact conflict. With Athens being in close proximity to the Turkish Straits, it has a strategic advantage over most other Mediterranean ports. Also, the major non-NATO mission is the maintenance of stability between Egypt and Israel. Here again, Athens provides a good strategic location that will allow a rapid response to any Middle East crisis [Ref. 15].

The harbor at Athens was rated "good" by the USN even though no pierside berths were available for an aircraft carrier. The plan was for the carrier to anchor out in the harbor, and for the USN to construct a pier at some later date. Hotel services and shore power requirements were to be supplied via mobile utility support equipment (MUSE).[1] This would allow the carrier to go coldiron (shut down the

[1]Low pressure air and low pressure steam that are used to run laundry and galley equipment and to provide hot water and compartment heating are referred to as hotel services.

EXHIBIT II-1

SUMMARY OF PORT SURVEYS

	Strategic Location	Adequate Harbor	Jet Airfield	Adequate Ship Repair	Adequate Urban Support	Local Accept-ability	Additional Remarks
Athens	Good	Good	Marginal	Marginal	Good	Good	Can absorb full CVA task group
Augusta Bay/ Siracusa	Marginal	Marginal	Marginal	Poor or not at all	Marginal	Good	CVA anchors but will not accom-modate full Gp.
Gaeta	Marginal	Poor or not at all	Poor or not at all	Poor or not at all	Poor or not at all	Good	Too small for CVA
La Spezia	Marginal	Poor or not at all	Poor or not at all	Poor or not at all	Marginal	Good	Too small for CVA
Livorno	Marginal	Poor or not at all	Good	Poor or not at all	Good	Good	Not CVA capable
Naples	Marginal	Marginal	Good	Marginal	Poor or not at all	Good	Harbor urban area too crowded
Taranto	Marginal	Poor or not at all	Good	Poor or not at all	Marginal	Good	Too small for full group

SOURCE: U.S. Congress, House, Committee on Foreign Affairs, Joint Hearings before the Sub-committees on Europe and the Near East, Political and Strategic Implications of Homeporting in Greece, 92d Cong., 2nd sess., 1972, p. 21

engineering plant) to perform routine repairs and preventive maintenance on its power plant machinery. The rating of "good" was given only because the harbor entrance, depth, and room for necessary pier construction exceeded the USN's minimum requirements [Ref. 16].

Elefsis Airfield was located about 15 miles from Megara, the proposed carrier anchorage. Although the airfield was considered marginal because it lacked the facilities for proper aircraft maintenance and upkeep, it was judged sufficient because there was space available to make the required improvements.

At Megara there were no ship repair facilities available [Ref. 17]. Repairs would be accomplished through the extensive repair capabilities onboard the aircraft carrier, and through USN repair ships deployed to the Mediterranean Sea.

The city of Athens and its suburbs provided an adequate number of housing and apartment units with a full range of rental prices [Ref. 18]. To meet the other needs of the dependents, a USN vessel, the USS Sanctuary (AH-17), was converted into a Dependent Support Ship. The medical facilities onboard the Sanctuary were upgraded to include maternity, gynecology, and obstetrics sections. Exchange facilities also were added. The official role of the Sanctuary was to aid military dependents in overseas ports where other U.S. facilities either are inadequate or not available [Ref. 19].

Local acceptability was not really a factor. All of the major ports considered were rated "good" [Ref. 20].

The last factor of concern was keeping the destroyers and the aircraft carrier in the same port. The ships were able to be located together in Athens, although the distance between the destroyers and

the aircraft carrier was 13 to 14 miles by sea, and about 15 miles by land [Ref. 21].

The purpose of elucidating the criteria listed by the USN was to demonstrate that the requirements for homeporting an aircraft carrier in the Mediterranean Sea can be rather Spartan-like in the initial phase, and that needed improvements can be made as political and economic environments allow. Mobile support assets such as the USS Sanctuary and MUSE could reduce drastically the cost of required shore facilities, and they also have the added advantage of being able to be used elsewhere should the homeporting plan be changed or aborted [Ref. 22]. In effect, with a minimal time delay, an aircraft carrier could be homeported in the Mediterranean.

D. THE HOMEPORTING ALTERNATIVE

In discussing the homeporting alternative, the authors will describe briefly some of the alternatives that the USN considered in the attempt to homeport a carrier in Athens, Greece. In the authors' opinion, the issues addressed in 1973 are applicable to today's carrier force shortage problems. Although the objective of this thesis is to develop a cost model for comparing the cost of deployment to the costs of homeporting, the authors feel that it is necessary to mention some of these alternative methods of meeting naval force requirements in the Mediterranean Sea.

In 1973 the USN faced the problem of having its aircraft carrier force reduced from 16 to 12, due to the fact that Congress was not willing to spend the necessary funds to either overhaul aging carriers or to build new carriers. Chief of Naval Operations (CNO), Admiral

Elmo Zumwalt, USN, felt that homeporting a carrier in the Mediterranean Sea would reduce the impact of decreasing the carrier fleet by 25%. Congress not only agreed with the CNO that homeporting in the Mediterranean Sea would provide relief to the carrier shortage problem, but they also were attracted to the fact that homeporting was much less expensive than many other alternatives for meeting naval force requirements.

As stated by the Assistant to the Secretary of State for Congressional Relations, David M. Abshire, in 1972 on the issue of homeporting an aircraft carrier in Greece,

> "The homeporting concept is related most directly to problems of personnel retention, force levels, and budgetary constraints rather than to strategic considerations. There are, of course, strategic and military advantages which flow from the arrangement, but they were not the primary motivating consideration." [Ref. 23].

Today the military issues at hand continue to be personnel retention, force levels, and budgetary constraints [Ref. 24]. Although the Reagan administration is dedicated to improving the military in these areas, the authors contend that the slow reaction time of Congress, the lag time of procurement, and the inability of improved retention to make an immediate and significant impact on reducing personnel shortages indicate that real relief for the USN is several years away.

Today the USN has 12 carriers in its fleet. Additional mission requirements for carriers due to political unrest in both Korea and Iran have severely overburdened the carrier fleet. At times, the USN has not been able to fulfill its two carrier commitments in the Mediterranean Sea. Some of the options to reduce this burden are the same as in 1973: building new carriers, recommissioning older

carriers, or homeporting a carrier in the Mediterranean Sea. Each of these alternatives will be discussed in turn.

To military planners, an obvious alternative to maintaining adequate naval presence in the Mediterranean Sea is to build more aircraft carriers. This would entail procurement of both the carrier and a complete air wing of approximately 85 to 95 aircraft, and assembling over 5,000 military personnel to man both the carrier and its air wing. Besides costing several billions of dollars, the procurement process would take years to complete, and if retention is not significantly improved, manning of the carrier and its air wing would be either difficult or impossible. This alternative, in the authors' opinion, would not be viable in the shortrun.[1]

Another alternative with a faster response time would be to reactivate some of the decommissioned aircraft carriers. Overhaul and reoutfitting would take between two, and two and one-half years to complete. There still is the problem of procuring aircraft and assembling a sufficient number of trained personnel to man the aircraft carrier and its air wing. Again, this alternative seems to be more of a long range option rather than a short term answer.

Overseas homeporting of an aircraft carrier can be a viable short term alternative. To begin with, there would be no immediate procurement or manning difficulties. As soon as political considerations could be negotiated, an aircraft carrier could commence a phased

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[1]Even though the USS Vinson (CVN-70) is scheduled to join the fleet in 1982, the USS Coral Sea (CV-43) is scheduled to be decommissioned before 1985 [Ref. 25].

homeporting procedure in almost any of the major ports in the Mediterranean Sea. The mobile support assets mentioned earlier would meet the initial support requirements, and more permanent facilities could be constructed as the need arises. With a fraction of the time and cost needed for the two previous alternatives, the USN could project the required level of naval presence in the Mediterranean Sea. By adopting the homeporting alternative, expensive fuel would not be wasted on long transits necessary for aircraft carriers to deploy from the U.S. to the Mediterranean Sea. And, according to a USN study, an aircraft carrier homeported overseas can maintain the same state of readiness as an aircraft carrier that deploys but the time spent in homeport for the overseas homeported carrier increases from 127 to 155 days per year [Ref. 26]. This would allow more time for family life to the personnel of the carrier and its air wing, who continually are subjected to long, arduous days at sea. By increasing the time in homeport by one month per year, USN surveys indicate that retention would be improved [Ref. 27].

Finally, if homeporting is considered only as a shortrun option, the USN could reap the benefits aforementioned while embarking upon programs that will meet the long term needs of the USN without the time and manpower pressures previously discussed. In short, as a minimum, the USN could buy time to develop more permanent solutions to the problem of relieving the burden now placed on the carrier fleet, and if the budget increases promised by the Reagan administration do not materialize, and/or the benefits of overseas homeporting in the Mediterranean Sea continue to outweight those of deploying, then homeporting an aircraft carrier in the Mediterranean Sea also could become a viable long term alternative.

E. ASSUMPTIONS AND DEFINITIONS

Before developing the cost model that measures the financial costs of deploying versus homeporting, it is necessary to discuss the authors' assumptions and definitions. Basic to the model is that only relevant costs will be considered. Relevant costs are defined as those costs which are differential between the alternatives being considered [Ref. 28]. Therefore, relevant costs do not include sunk costs, which are costs that already have been incurred, and which cannot be changed by any decision made now or in the future, nor do they include future costs that do not differ between the alternatives at hand [Ref. 29].

The relevant costs of the alternatives fall into one of two categories: costs that are unique to a particular alternative such as construction costs of facilities to accommodate overseas homeporting, and costs which are differential (the same category of cost, but the amount of cost between alternatives is different) such as military pay and fuel costs. Each cost used in the model will be discussed fully in subsequent chapters.

The model presented by the authors has been developed on the following assumptions. Deployment length will be set at the USN ideal standard of six months [Ref. 30]. The type of aircraft carrier considered will be conventionally powered (powered by steam producing boilers that burn fossil fuel). The crew size of the aircraft carrier will be 3,010 (266 officers and 2,844 enlisted). The number of personnel to man the air wing will be 2,400 (356 officers and 2,044 enlisted). Appendix F shows the rank and pay grade distribution for

both the carrier and the air wing. Dependent personnel will be calculated at 2.6 dependents per married officer, and 2.2 dependents per married enlisted [Ref. 31]. The average tour of duty for personnel homeported overseas will be three years. Military personnel and dependent travel costs will be computed from Norfolk, Virginia to the overseas city in which the aircraft carrier is homeported. These assumptions will be reviewed with the reader as applicable in the following chapters.

The authors conceptualized the cost model to apply to any military situation where the alternatives are deploying or homeporting (or stationing) a military unit overseas. To this end, the model will contain some cost elements that may be insignificant or not applicable to specific cases. The authors feel that by building universality into the model, other significant military decisions with a similar problem base could be easily enhanced. Finally, the authors view the model as a decision support device, and not one that necessarily produces an optimal solution.

F. SUMMARY

In this chapter, the authors have provided the reader with historical information on the role the USN and, in particular, the role its aircraft carriers play in the Mediterranean Sea. This information leads one to consider alternative methods of aleviating the demands placed on the current carrier fleet when viewed in the light of recent additional USN mission requirements associated with Iran and Korea [Ref. 32].

The authors examined a recent attempt to homeport a carrier in the Mediterranean Sea to familarize the reader with both factors that must be considered when homeporting overseas, and the minimum required levels of support associated with the implementation and continuance of the homeporting option. With this foundation data, the authors explored alternatives to the present USN policy of deployment. The authors concluded that a viable alternative under present socio-economic conditions in the U.S. is to homeport an aircraft carrier in the Mediterranean Sea.

The authors then made an initial set of assumptions upon which analysis in later chapters will be based. The assumptions will each be examined and explained later in pertinent parts of this thesis to help maintain a cohesion between the authors' assumptions, models, and analyses.

With the background information discussed in this chapter, the authors will develop the deployment cost model in Chapter III, and the homeporting cost model in Chapter V. Virtually all succeeding chapters will draw upon and reference data from Chapter II.

III. DEPLOYMENT COST MODEL

A. INTRODUCTION

As stated earlier, the development of the cost model undertaken in this chapter will be general in nature. (Chapter IV will use the model developed in this chapter for a specific case: the ascertainment of the cost of deploying an aircraft carrier from the United States to the Mediterranean Sea.) The model developed in the succeeding pages is one that will apply to any military situation in which the relevant cost of deployment of a military unit must be computed and compared to the relevant costs of homeporting.

The model will be composed of cost categories and cost elements. Cost categories will be the major areas of cost considerations. Each cost category will be composed of cost elements. The cost elements will be specific costs related to a major area of cost, the cost category. Therefore, the cost model will contain some cost elements that are insignificant, or not applicable to specific cases in order to capture the attribute of universality. Only relevant costs, as defined in Chapter II, will be considered in the model.

In Chapters VI and VII, the costs of deployment as described in this chapter will be compared to the costs of homeporting as described in Chapter V to determine the financial feasibility of the homeporting alternative. In this chapter, the costs of deployment will be discussed first by major cost categories such as military pay, then by the cost elements of each category such as Family Separation Allowance, Type II (FSA). In this way the reader will be able to determine which cost

elements of each category would apply to any specific case of interest.

B. MILITARY PAY

One aspect of the military pay system is to compensate military personnel who must be assigned temporary duty at a location other than at their permanent duty assignment or homeport. In this aspect of the category of military pay, there are two relevant cost elements: Family Separation Allowance, Type II (FSA), and Temporary Duty Allowance (TDA). Recently, military pay has changed in order to help military personnel afford reasonable housing. This change came with the advent of Variable Housing Allowance (VHA). This is the third and final relevant cost element of military pay. Each will be discussed and defined separately.

FSA is paid to military personnel who are E-4 and above with more than four years of active duty service, have dependents, and are separated from their dependents for official duty reasons for more than 30 continuous days. This entitlement is intended to compensate for added expenses incurred due to the forced separation of the military member from his or her dependents. FSA is not authorized in time of war, or a national emergency declared by Congress. The current rate for FSA is $30.00 per month for each military member. The rate is the same for both officer and enlisted members [Ref. 33].

TDA is a per diem allowance that is paid to military members who must be separated from their ship or other permanent duty station to perform official duty. This allowance is intended to compensate military members for meals, lodging, official communications (telephone or telegraph), personal services (laundry and dry cleaning),

and local transportation that is not covered by travel allowance, and that must be used to fulfill official duties. Although the maximum TDA or per diem is established by law, the actual rate varies according to each location in the world, and the rate is different for officer and enlisted members [Ref. 34].

VHA is paid to all military personnel who are eligible for Basic Allowance for Quarters (BAQ), and who are occupying nongovernment quarters within the U.S., excluding Alaska and Hawaii. This allowance is intended to adjust for the difference in housing costs throughout the 48 contiguous States. VHA is calculated as a percentage of BAQ, as shown in Appendices B and C. These Appendices also show that BAQ rates vary only as a function of paygrade and dependency status. VHA is computed by a special BAQ multiplier that varies by the location within the U.S., and by paygrade groups. Presently the paygrade groups are: O10-O4 and W4, O3-O1 and W3-W1, E9-E7, E6-E4, and E3-E1. Usually each of these five groups has a different BAQ multiplier.

C. UNIT TRANSPORTATION COSTS

Each military unit that deploys overseas must incur the expenses of moving its personnel, material, and equipment. In some cases, such as deploying U.S. Navy ships, the only significant cost incurred is the cost of the fuel consumed to transit from the homeport in the U.S. to the deployment operating area overseas. In other cases, the movement of unit personnel, material, and equipment requires support from other military units such as the Military Airlift Command (MAC) at a significantly higher cost [Ref. 35]. These costs are higher because in addition to the cost of fuel for the transit, charges are made for personnel and equipment necessary to provide the transportation service.

D. UNIT OPERATIONS COST

It is the opinion of the authors that many military units that have a cyclical deployment mission actually have a higher operation tempo (op tempo). that is, the number of days or flight hours per given period that a unit is engaged in actual or training operations, than units that are homeported (permanently stationed) overseas. This argument is based on the premise that it takes a higher op tempo to achieve the high state of readiness ratings required for overseas deployment than it does to maintain that high state of readiness while deployed.

The cost difference will be the sum of the costs of consumables such as fuel and munitions that are necessary to support the difference in op tempo. If, for example, a military unit that has a cyclical deployment mission requires more consumables to support training and actual operations between deployments than is necessary to support training and actual operations while on deployment, then unit operations cost can be calculated by multiplying the total cost difference by the ratio of deployment time to the time between deployments. The authors recognize that for some military units, the op tempo will not vary significantly between deployment and nondeployment periods. It is further recognized, that some military units may have a higher op tempo during deployments than between deployments. In the latter case, the unit operation costs will be added to the cost of homeporting.

E. DEPLOYMENT COST MODEL EQUATION

The major cost categories for determining the relevant costs of deployment are military pay, unit transportation costs, and unit

operation costs. Each category is broken down into its cost elements. The following is the symbolic representation of the authors' preceding conclusions:

1. Military Pay (Cm)

$$Cm = (12) \times (Mf \times Nd) + (365) \times (Mto \times No) + (365) \times (Mte \times Ne) + (12) \sum_{E1}^{O10} [Ns \times BAQs \times BAQm) + (Nwd \times BAQwd \times BAQm)]$$

where Mf = Family Separation Allowance, Type II

Nd = Number of unit personnel E-4 and above with more than four years active duty and with dependents

Mto = Temporary Duty Allowance for officers

No = Number of unit officer personnel eligible for TDA

Mte = Temporary Duty Allowance for enlisted

Ne = Number of unit enlisted personnel eligible for TDA

Ns = Number of unit personnel by paygrade that do not have dependents and are eligible for BAQ, and that occupy nongovernment quarters

Nwd = Number of unit personnel by paygrade that have dependents and are eligible for BAQ, and that occupy nongovernment quarters

BAQs = Applicable Basic Allowance for Quarters (without dependent rate) for each paygrade

BAQwd = Applicable Basic Allowance for Quarters (with dependent rate) for each paygrade

BAQm = Applicable Allowance for Quarters multipliers by paygrade

$\sum_{E1}^{O10}$ = The sum of the cost of VHA of each paygrade from E1 to O10

2. Unit Transportation Costs (Ct)

$$Ct = (Qfl \times Pf) + Cs$$

where Qfl = Quantity of fuel consumed by the unit for transit

Pf = Price per fuel unit

Cs = Cost of support transportation from other military units

3. Unit Operation Cost = (Co)

$Co = [(Qf2 \times Pf) + (Qc \times Pc)]R$

where Qf2 = Quantity of fuel consumed to support higher op tempo during nondeployed status

Pf = Price per fuel unit

Qc = Quantity of other consumables to support higher op tempo during nondeployed status

Pc = Price per other consumable unit

The reader should note that there may be several (Qc x Pc) elements to this cost category depending on the different types of consumables necessary to support increased operations.

R = Ratio of the time deployed to time of one cycle (deployed time plus nondeployed time)

4. Total Cost of Deployment TCd (annual cost)

$TCd = Cm + Ct + Co$

F. SUMMARY

In this chapter the reader has been introduced to the authors' deployment cost model. The model is composed of three cost categories, and each cost category contains specific cost elements. By applying the model to a case where a military unit has a cyclical deployment mission, the relevant costs of deployment can be determined. The deployment cost model will be used in Chapter IV to determine the relevant cost of deploying an aircraft carrier from its homeport in the U.S. to the Mediterranean Sea. The relevant cost of deployment will then be compared to the relevant cost of

homeporting, which will be developed in later chapters, to determine if homeporting is a financially viable alternative to deployment.

IV. DEPLOYMENT COST MODEL APPLICATION

A. INTRODUCTION

In Chapter IV the deployment cost model as presented in Chapter III will be applied to the case of an aircraft carrier and its air wing that deploys from the eastern coast of the United States. Rather than choose a specific aircraft carrier, the authors will use a notional aircraft carrier and air wing to avoid the use of classified information, and to prevent overemphasis on detailed data that vary between different carrier types. Calculations will be based on the following assumptions. The aircraft carrier will be a conventionally powered type. Manning levels will be based on Ships Manning Documents and Squadron Manning Documents to approximate that of a John F. Kennedy class aircraft carrier. (See Appendices D, E, and F.)

The reasons the authors chose to evaluate a conventionally powered carrier as opposed to a nuclear powered carrier are that: currently there are no nuclear support facilities in the Mediterranean Sea, and fuel usage (both consumption for deployment transits and consumption rate to determine maximum steaming distance without refueling) is not a consideration for a nuclear carrier.[1] A final reason, in the author's opinion, is that many countries do not desire nuclear powered ships in their ports because such ships represent the possibility of a nuclear accident.

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[1]The average nuclear powered aircraft carrier has enough fuel to conduct normal operations for 13 years. [Ref. 36]

Each cost category (Military Pay, Unit Transportation Costs, and Unit Operation Costs) will be examined separately. The relevant costs of deployment will then be summarized and projected to ten years by use of present value analysis as delineated in Appendix A. The final cost figures will be the basis for comparison against the relevant costs of homeporting an aircraft carrier in the Mediterranean Sea. (See Chapters VI and VII.)

The cost of deployment will be based on the concept of a system of notional carriers (each with a six-month deployment) fulfilling the requirements of an aircraft carrier homeported overseas.

B. MILITARY PAY (Cm)

Military base pay, basic allowance for quarters (BAQ), and basic allowance for subsistence (BAS) vary only with paygrade, and in the case of base pay, with longevity or time in service. As delineated in Chapter III, the three relevant cost elements of this category are Family Separation Allowance, Type II (FSA); Temporary Duty Allowance, or per diem (TDA); and Variable Housing Allowance (VHA).

Appendix G was developed using the guidance of the Naval Facilities Engineering Command's Facilities Planning Criteria for Navy and Marine Corps Shore Installations (NAVFAC P-80). From this appendix, the number of personnel that are eligible for FSA can be calculated. For a notional aircraft carrier and its air wing, as previously described, the total number of personnel eligible for FSA is 1739. As stated in Chapter III, the current rate for FSA is $30.00 per month for each military member. The cost element FSA

is simply calculated as follows. (Symbology is explained in Chapter III.)

Mf = $30.00

Nd = 1739

Mf x Nd = $30.00 x 1759 = $52,170

This is the monthly cost, and it will be amortized for cost comparison later in the chapter.

It is the authors' opinion that TDA for an aircraft carrier and its air wing is not really a significant factor in calculating the overall costs of deployment. Although some personnel do receive TDA for many varied reasons, the vast majority of the personnel are berthed and fed onboard the carrier. The authors feel that those personnel who do receive TDA from a deploying aircraft carrier would not be significantly different than the number of personnel who would receive TDA from an aircraft carrier homeported in the Mediterranean Sea.

Variable Housing Allowance, as stated in Chapter III, is paid to all military personnel who are eligible for BAQ, and who are occupying nongovernment quarters within the 48 contiguous States. The present policy of the U.S. Navy concerning personnel assigned to duty onboard ship is that all personnel with dependents, and all personnel E7 and above without dependents, may receive BAQ, and may occupy non-quarters.

Aircraft carriers that deploy to the Mediterranean Sea are homeported out of Norfolk, Virginia, and Mayport, Florida. At the time of this writing, the BAQ multipliers for the two areas were the same. Those BAQ multipliers for calculating VHA are as follows: O6-O4 and W4 .30, O3-O1 and W3-W1 .20, E9-E7 .35, E6-E4 .30, and E3-E1 .45. The VHA rates for Norfolk and Mayport are calculated in Table IV-1.

TABLE IV-1

VHA RATES FOR NORFOLK AND MAYPORT

Paygrade	BAQ Mult.	With Dependents BAQ	With Dependents VHA	Without Dependents BAQ	Without Dependents VHA
06	.30	$468.60	$140.58	$384.00	$115.20
05	.30	426.30	127.89	354.00	106.20
04	.30	380.40	114.12	315.00	94.50
03	.20	342.00	68.40	277.20	55.44
02	.20	304.50	60.90	240.60	48.12
01	.20	244.50	48.90	187.80	37.56
W4	.30	366.60	109.98	303.60	91.08
W3	.20	333.90	66.78	270.90	54.16
W2	.20	299.70	59.94	235.50	47.10
W1	.20	275.40	55.08	212.70	42.54
E9	.35	322.50	112.87	229.20	80.22
E8	.35	297.90	104.27	211.20	73.92
E7	.35	277.20	97.02	179.70	62.80
E6	.30	255.00	76.50	163.20	48.96
E5	.30	234.30	70.26	156.90	47.07
E4	.30	206.10	61.85	138.30	41.49
E3	.45	179.70	53.91	123.60	55.62
E2	.45	179.70	53.91	109.20	49.14
E1	.45	179.70	53.91	103.20	46.44

It has been the authors' experience that the eligibility requirements for government quarters, and the number of government quarters vary widely with location and time. Because there are so many factors that influence both the eligibility requirements and the number of government units available, the authors have elected to calculate VHA based on arbitrary nongovernment quarters occupancy rates of 25, 50, 75, and 100 percent. The authors feel that this approach will enhance the final cost comparisons in later chapters because it will not tie the analysis to a single set of factors that influence occupancy of nongovernment quarters such as inflation, availability of loans for purchasing housing, and the number of rental housing units provided by local economy.

Using the parameters previously discussed, VHA now can be calculated. Table IV-2 uses the equation

$$\sum_{E1}^{Q10} [(Ns \times BAQs \times BAQm) + (Nwd \times BAQwd \times BAQm)]$$

which was developed in Chapter III to calculate VHA costs at various nongovernment quarters occupancy levels. It should be noted that these figures represent monthly costs, and that these costs will be amortized at the end of the chapter.

C. UNIT TRANSPORTATION COSTS (Ct)

An aircraft carrier, being a huge mobile platform with a tremendous amount of storage space, carries virtually all of its personnel, material, and equipment (including aircraft) when making a transit to the deployment operating area. No significant costs are incurred for the transit other than the fuel consumed by the aircraft carrier itself.

TABLE IV-2

VHA COSTS FOR NORFOLK AND MAYPORT

Paygrade	Number (With Dependents/Without Dependents)	Occupancy Rates of Nongovernment Quarters 25%	50%	75%	100%
06	2/0	70/0	141/0	211/0	281/0
05	53/2	1695/53	3386/106	5081/159	6778/212
04	85/6	2425/142	4850/284	7275/426	9700/567
03	142/33	2428/457	4856/915	7284/1372	9713/1830
02	107/85	1629/1023	3258/2045	4887/3068	6516/4090
01	20/28	245/263	489/526	734/789	978/1052
W4	8/0	220/0	440/0	660/0	880/0
W3	10/0	167/0	334/0	501/0	668/0
W2	31/10	465/118	929/236	1394/354	1858/471
W1	0/0	0/0	0/0	0/0	0/0
E9	38/2	1072/40	2145/80	3217/120	4289/160
E8	62/2	1642/37	3285/74	4927/111	6569/148
E7	146/9	3541/141	7082/283	10623/425	14165/566
E6*	425/60	8128	16256	24384	32513
E5	526/385	9239	18478	27717	36957
E4	327/766	5056	10113	15169	20225
E3	231/1133	3113	6227	9340	12453
E2	48/573	647	1249	1941	2588
E1	7/147	94	189	283	377
TOTAL W/DEPEND.		41,876	83,752	125,628	167,508
TOTAL W/O DEPEND.		2274	4549	6824	9096
TOTAL OF BOTH		$44,150	$88,301	$132,452	$176,604

*E6 and below who are assigned duty onboard ships, and who do not have dependents are not eligible for BAQor VHA.

Since the cost of support from other military units (Cs) is zero, the Unit Transportation Cost (Ct) becomes the quantity of fuel consumed by the ship for the transit (both to and from the deployment operating area) times the price per fuel unit (Pf).

Chart IV uses the equation Ct - Qfl x Pf to compute the cost of fuel consumed during the deployment transit at various speeds. It has been the authors' line experience that most transits are conducted at an average speed of 16 knots. The costs associated with other transit speeds will be used later in the chapter.

TABLE IV-3

FUEL COST DATA (BASED ON ONE WAY DEPLOYMENT TRANSIT)

Speed (in knots)	12	16	20	30
Fuel Used (Gals)	735,870	759,574	937,500	1,875,000
Cost (@ $1.33/Gal)	$978,707	$1,010,233	$1,246,875	$2,493,750

[Ref. 37]

It should be noted that the costs in Table IV-3 are not entirely differential. That is, unless a carrier that was homeported overseas remained coldiron, there would be some fuel cost associated with the operation of the carrier. Therefore, the costs presented in Table IV-3 are estimates of the maximum differential fuel costs associated with transits for deployment.

D. UNIT OPERATION COST (Co)

According to USN studies, an aircraft carrier and its air wing, deploying to the Mediterranean Sea, would spend approximately the same number of days at sea as an aircraft carrier and air wing homeported in the Mediterranean Sea. The study presented by Admiral Gaddis as testimony before the Subcommittee on Military Construction Appropriations stated that the average time spent at sea per year for a deploying carrier is 145 days, and for a carrier homeported in the Mediterranean, the number would be 146 days. This predication is based on a five carrier force level in the U.S. Atlantic Fleet, and a commitment to keep two carriers deployed to the Mediterranean Sea [Ref. 38].

As described in Chapter III, the Unit Operation Cost is based on the concept that a *higher* operational tempo is needed between deployments to achieve the required state of readiness and training to support deployment than is needed to maintain that required state of readiness and training while actually deployed. Since USN studies show no significant difference in op tempo for the two alternatives of deploying and homeporting, Co takes on a value of zero.

E. TEN YEAR DEPLOYMENT COSTS

Now that each cost element has been examined, they must be time adjusted to allow comparison between the two alternatives of deploying versus homeporting. Appendix A will be used as a guide in developing the time adjusted cost figures. Again, the symbology used in this section is fully explained in Chapter III.

In Section B of this chapter, three cost elements of Military Pay were examined. Family Separation Allowance was calculated to be $52,170 per month. Temporary Duty Allowance was assumed to be insignificant by the authors, and therefore considered to be zero. Variable Housing Allowance was computed to be $88,301 per month, based on a 50 percent occupancy rate of nongovernment quarters. (Costs associated with occupancy rates of 25 and 75 percent also will be included in the analysis.)

Using the monthly costs of each cost element, the yearly costs can be simply calculated as follows:

FSA (yearly)	$52,170 x 12	= $ 626,040
VHA (yearly @ 50%)	$88,301 x 12	= $1,059,612
VHA (yearly @ 25%)	$44,150 x 12	= $ 529,800
VHA (yearly @ 75%)	$132,452 x 12	= $1,589,424

It is the authors' contention that the level of VHA will not really vary by any significant amount over any ten year period. Therefore, a representative VHA level of 50% will be used to determine this cost element. Since the overall variance of VHA compared to the total cost of deployment is approximately ten percent, the authors feel justified in using this approach.

Next, Unit Transportation Costs (Ct) were examined. Although Table IV-4 shows a wide variance in transit fuel costs due to the variance in transit speeds, the most likely transit speed, based on the authors' experience, is 16 knots. Computations at 12, 20, and 30 knots will be made to demonstrate to the reader how sensitive Ct is to a change in transit speed, especially higher transit speeds.

TABLE IV-4

YEARLY FUEL COSTS FOR TWO ROUND TRIP DEPLOYMENT TRANSITS

Speed (in knots)	12	16	20	30
Fuel Used (Gals	2,943,480	3,038,296	7,500,000	$7,500,000
Cost (@ $1.33/Gal)	$3,914,828	$4,040,933	$4,985,500	$9,975,000

[Ref. 39]

Again, following Appendix A, the yearly transit costs will be calculated. As stated in Chapter II, the Navy employs a 18-month deployment cycle. On this basis, two round trip transits will be made per year by a system of notional carriers. In Table IV-5, the yearly costs of deployment are calculated.

F. COST ANALYSIS

For the final tabulation of deployment costs, the authors will use a three estimate approach of most likely, least cost, and most cost. When using such a structure, it is the authors' opinion that the categories of least cost and most cost should be well within the realm of possibility rather than using extreme cases that only could be possible in the rarest of circumstances. Tables throughout this chapter provide the reader with the information to calculate extreme cases if he so desires.

Table IV-5 shows the yearly costs for each of the three categories. The authors feel that to achieve a more accurate cost comparison between the alternatives of deploying versus homeporting, that the two alternatives must be compared over a period of ten years. The reason is that

TABLE IV-5

YEARLY COSTS OF THE DEPLOYMENT ALTERNATIVE

	Most Likely	Least Cost	Most Cost
FSA	$ 626,000	$ 626,000	$ 626,000
VHA	$1,059,612	$1,059,612	$1,059,612
Ct	$4,040,933	$3,914,828	$4,985,000
Co	0	0	0
TOTAL	$5,726,585	$5,600,440	$6,670,612

the homeporting alternative requires certain nonrecurring costs such as construction. In the authors' opinion, any comparison merely examining the two alternatives over only one year would tend to be biased toward the alternative of deploying due to the high nonrecurring costs associated with the homeporting alternative. (Chapter V will discuss this point in more detail.)

TABLE IV-6

DISCOUNTED COSTS OF DEPLOYMENT OVER TEN YEARS

	Most Likely	Least Cost	Most Cost
FSA	$4,035,822	$4,035,822	$4,035,822
VHA	$6,831,318	$6,831,318	$6,831,318
Ct	$26,051,189	$25,238,896	$32,138,295
Co	0	0	0
TOTAL	$36,918,329	$36,106,036	$43,005,435

Using the format as presented in Table IV-5, Table IV-6 above applies present value analysis over a period of ten years. As prescribed by Appendix A, a discount value of ten percent is used. The total figures in Table IV-6 represents the figures that will be used to make cost comparisons in later chapters.

G. SUMMARY

In this chapter the authors have applied the deployment cost model developed in Chapter III to the case of an aircraft carrier deploying to the Mediterranean Sea from the eastern coast of the United States. From the cost model, the authors determined that the applicable costs of the deployment alternatives were Family Separation Allowance, Variable Housing Allowance, and the cost of fuel consumed by the carrier during deployment transits (Ct).

After determining the costs, the authors time-adjusted each cost for a period of one year. Then these yearly costs were projected over a period of ten years and subjected to present value analysis using a discount value of ten percent, as required by Appendix A.

Because the level of VHA and Ct varies depending on the particular circumstances associated with a specific carrier over time, the authors have chosen to estimate the cost of the deployment alternative by employing three different cost cases: most likely, least cost, and most cost.

In Chapter V the cost model for homeporting will be developed, and this model will be applied to specific cases in Chapters VI and VII. Chapter VIII will use the information obtained in previous chapters to conduct a comparison of the suggested alternatives.

V. HOMEPORTING COST MODEL

A. INTRODUCTION

As stated earlier, the development of the cost model undertaken in this chapter will be general in regard to its applicability. (Chapters VI and VII will use the model developed for two specific cases: the ascertainment of the cost of homeporting an aircraft carrier in Rota, Spain, and in Naples, Italy.) Again in the authors' opinion, the model developed in the succeeding pages is one that will apply to any military situation in which the relevant costs of homeporting a military unit must be computed and compared to the relevant costs of deploying units to fill the same overseas mission. Therefore, the cost model will contain some cost elements that are insignificant, or not applicable to specific cases, to capture the attribute of universality. The homeporting cost model will consist of three cost categories with specific cost elements indigenous to each category. Only relevant costs, as defined in Chapter II, will be considered in the model.

In Chapters VI and VII, the costs of homeporting as described in this chapter will be compared to the costs of deploying as described in Chapters III and IV to determine the financial feasibility of the homeporting alternative. In this chapter, the costs of homeporting will be discussed first by major cost category such as travel and transportation, and then by the cost elements of each category such as member and dependent travel, privately owned vehicle transportation, and household goods transportation. Cost categories and elements are defined in Chapter III.) In this way the reader will

be able to determine which elements of each category would apply to any specific case of interest.

B. ALLOWANCES

The three allowances to be considered are Housing Allowance (HOLA), Cost of Living Allowance (COLA), and Variable Housing Allowance (VHA).

HOLA is part of a larger category of entitlements called station allowances. HOLA is authorized for the purpose of defraying the average excess costs of housing experienced by members on permanent duty at places outside the United States. The excess costs are derived by comparison of the average cost of housing of members in each area outside the U.S., with the average cost of housing for similar members in the U.S. HOLA is payable to a member with or without dependents in accordance with the per diem rates established in the Joint Travel Regulations (JTR), Volume I. Entitlement generally begins on the day a member reports to a new permanent station, and terminates the day before departure, in compliance with Permanent Change of Station (PCS) orders. It is payable at all times except when government quarters are assigned to, or occupied jointly by the member and his or her dependents [Ref. 40].

COLA is very similar to HOLA. It is authorized for the purpose of defraying the average excess costs of living experienced by members on permanent duty outside the U.S. As with HOLA, the excess costs are derived by comparing the average cost of living of members in each area outside the U.S. with average cost of living for similar members in the U.S. COLA also is payable to a member with or without dependents in accordance with the per diem rates established in JTR, Volume I.

Entitlement begins on the day the member reports to a new permanent station, and ends the day before departure in compliance with PCS orders [Ref. 41]. Basically, COLA is paid to single members only if government messing is not available, whether or not in government quarters. COLA is paid to members with dependents notwithstanding the availability of government quarters.

JTR, Volume I, Appendix A must be consulted to determine if HOLA and/or COLA are authorized for a specific area outside the U.S. Once this is determined, Appendix B for HOLA, and Appendix C for COLA will be used to determine individual per diem rates for members with or without dependents.

VHA is paid to a member with dependents who chooses to leave his or her family in the U.S., at the rate applicable for the area within the U.S. in which the member's dependents actually reside. VHA also may be paid concurrently with HOLA if the member's family remains in the U.S. and government quarters are not available to the member overseas [Ref. 42].

C. TRAVEL AND TRANSPORTATION

All members, regardless of paygrade, and their dependents are entitled to transportation to an overseas duty station at government expense upon permanent change of station orders. There are some rare exceptions, and JTR, Volume I must be consulted [Ref. 43]. Transportation normally is coordinated through the efforts of the Military Airlift Command (MAC). However, some commercial travel may be required either within the U.S. to the primary port call, or outside of the U.S. from the port of entry to the specific duty station/homeport. In any particular application of the cost model, all these

factors must be included in determining member and dependent travel. MAC flight costs are standard for all seats to a given destination. Commercial costs will vary with distance and age of dependents (children under certain ages may be traveling at less than full fare).

A service member is allowed to have one privately owned vehicle shipped at government expense when in receipt of PCS orders overseas. POV includes regular automobiles, jeeps, station wagons, small buses, motorcycles, snowmobiles, and pickup or panel trucks. Vehicles are measured by a measurement-ton (MT) standard, which equals length times height times width divided by 40. The average car is 12 MT without cost to the owner. Any additional cost will be borne by the owner [Ref. 44].

The owners are responsible for ensuring that the vehicles arrive at one of the designated departure points (terminals). They are paid travel expenses (currently 13¢ a mile and one day's per diem at a flat rate of $50 per day) to offset the cost of transporting the POV from their current duty station/homeport to the designated departure point [Ref. 45].

Although there is no statistical evidence to verify the percentage of individuals who elect to ship POV's overseas, transportation office personnel content that it is a function of paygrade and being married. Because of the lack of specific information on this point, the authors will assume that all married personnel, and E5 or above without dependents, will ship their POVs [Ref. 46].

Transportation of household goods is an entitlement a member receives when ordered from one duty station to another (PCS). This

transportation is authorized by mode, including commercial air, which results in the lowest cost to the government while providing satisfactory service. Weight allowances determine the amount by paygrade that a member may have transported at government expense. This allowance is exclusive of baggage carried by hand in the transportation of personnel. Any amount shipped above allowance results in a cost borne by the member [Ref. 47].

D. CONSTRUCTION COSTS

Construction costs fall into a very general category, and may include the following type items: additional family housing, dependent schools, medical/dental facilities, recreation facilities, and additional operational support facilities. The construction costs will have to be tailored to each specific situation, as will be done in Chapters VI and VII, depending on what additional support facilities are required or desired.

E. MISCELLANEOUS COSTS

Miscellaneous costs, by definition, also fall into a very general category, and may include the following type items: land leasing by the U.S. Government from a foreign country, land purchasing, and the transfer of or hiring of additional support personnel not directly attached to the unit being moved. The miscellaneous costs will have to be considered in each specific situation, as will be done in Chapters VI and VII, depending on what is required or desired.

F. HOMEPORTING COST MODEL EQUATION

The major cost categories for determining the relevant annual costs of homeporting are Allowances, Travel and Transportation,

Construction Costs, and Miscellaneous Costs. Each category is broken down into its cost elements. The following is the symbolic representation of the authors' preceding conclusions:

1. Allowances (Ca)

$$Ca = \sum_{E1}^{010} \{(365) \times [(Ns1 \times Hs) + (Ns2 \times Cs) + (Nwdn \times Hwd) + (Nwd \times Cwd)] + [(12) \times (Nwdo \times VHAwd)]\}$$

where:

Ns1 = Number of unit personnel by paygrade that do not have dependents, and do not live in government quarters.

Ns2 = Number of unit personnel by paygrade that do not have dependents.

Hs = Applicable HOLA (without dependents) for each paygrade

Cs = Applicable COLA (without dependents) for each paygrade (paid only when government messing is not available).

Nwd = Number of unit personnel by paygrade that have dependents.

Nwdn = Number of unit personnel by paygrade that have dependents, and do not live in government quarters.

Hwd = Applicable HOLA (with dependents) for each paygrade.

Nwdo = Number of personnel by paygrade that have dependents, and choose to leave them in the U.S.

VHAwd = BAQwd x BAQm as defined in Chapter III

Cwd = Applicable COLA (with dependents) for each paygrade

2. Travel and Transportation (Ctt)

$$Ctt = (Fm \times Np) + [(Fc \times (Nm + Ndf)] + (RFc \times Ndr) + (Nv \times Vco)$$

$$+ (Nv \times Cpd) + (Nvm \times Cpm) + \sum_{E1}^{O10} (N_o \times Pa \times Cpp)$$

where: Fm = Cost of Mac flight per seat.

Np = Number of personnel, both members and dependents that fly MAC.

Fc = Cost of commercial flight per seat.

Nm = Number of military personnel that fly commercial.

Ndf = Number of dependents full fare that fly commercial.

RFc = Applicable reduced rate fare per seat commercial flight.

Ndr = Number of dependents at the applicable reduced rate.

Nv = Number of personnel shipping POVs (number of vehicles shipped).

Vco = Vehicle transportation cost overseas figured at $2.24 per cubic foot, 40 cubic feet per MT, and 12 MT average [Ref. 48].

Cpd = Flat rate per diem.

Nvm = Number of vehicle miles.

Cpm = Cost per mile (currently 13¢).

N_o = Number of unit personnel by paygrade that move dependents overseas.

Pa = Average number of pounds of household goods shipped per paygrade.

Cpp = Cost per pound.

3. Construction Costs (Cc)

$Cc = (Cca + Ccb + \ldots Ccn)$

where: Cca = Construction cost of item a.

Ccb = Construction cost of item b.

Ccn = Construction cost of item n.

4. Miscellaneous Costs (Cmm)

$Cmm = (Cmma + Cmmb + \ldots Cmmn)$

where: Cmma = Miscellaneous cost of item a.

Cmmb = Miscellaneous cost of item b.

Cmmn = Miscellaneous cost of item n.

5. Total cost of Homeporting TCh (annual cost)

$TCh = Ca + Ctt + Cc + Cmm$

G. SUMMARY

In this chapter the reader has been introduced to the authors' homeporting cost model. The model is composed of three cost categories, and each cost category contains specific cost elements.

By applying the model to a case where a military unit is homeported overseas, the relevant costs of homeporting can be determined. The homeporting cost model will be used in Chapters VI and VII to determine the relevant cost of homeporting an aircraft carrier in Rota, Spain, and in Naples, Italy. The relevant cost of homeporting will then be compared to the relevant cost of deployment to determine if homeporting is a financially viable alternative to deployment.

VI. ANALYSIS OF HOMEPORTING IN ROTA, SPAIN

A. INTRODUCTION

Chapter VI basically is an application of the homeporting cost model developed in Chapter V for the specific case in which an aircraft carrier and its air wing's homeport is shifted from Norfolk, Virginia to Rota, Spain. Certain assumptions will be made in each cost category to facilitate the cost computations.

In the cost category of Allowances, (Ca), and specifically the cost element wherein Variable Housing Allowance (VHA) is paid to members who leave their families in the United States, it will be assumed that dependents not going to Rota will be left in the Norfolk, Virginia area. It also will be assumed that single members live aboard the ship.

In the cost category of Travel and Transportation, (Ctt), and specifically the cost element of dependent travel, it will be assumed that dependents moving overseas will fly Military Airlift Command (MAC) from the Naval Air Station (NAS), Norfolk, to Rota. For the cost element of Household goods transportation, it will be assumed that all household goods are shipped from Norfolk to Rota.

It the cost category of Construction (Cc), only major construction as deemed necessary for support in the opinion of the authors will be considered. Additional base loading requirements for the U. S. Navy are based on Naval Facilities Engineering Command Publication 80 (NAVFAC P-80), "Facility Planning Factor Criteria for Navy and Marine Corps Shore Installations," and the respective Basic

Facility Requirements List (BFRL) for each command. The NAVFAC P-80 manual provides facility planning factor criteria and other planning data for use in computing quantitative facility requirements, evaluating existing field facilities, and determining specific shore facilities requirements.

The respective BFRL contains a complete listing of all the facilities basic to the operation of the activity. When the BFRL is compared with the proposed mission change or personnel increase (addition of an aircraft carrier and its air wing in this case) at the activity, a facility deficiency is generated. This is the quantitative difference in terms of some unit of measure between a stated requirement for a facility and the assets available for the satisfaction of this requirement [Ref. 49].

In any actual USN use of the cost model, timely comparison of the BFRL and NAVFAC P-80 would have to be made to determine specific construction requirements. However, in this case, notional levels of construction will be used; that is, additional construction will be considered based on the additional loading at 25, 50, 75, and 100 percent of the maximum. (One hundred percent construction is that level of construction necessary to fully support additional service members and their dependents; 75, 50, and 25 percent are the levels of construction that would fully support 75, 50, and 25 percent of the additional service members and their dependents, or support all of the additional personnel at reduced levels of 75, 50, and 25 per cent. These same notional levels also will be used in computing Allowances, and Travel and Transportation to facilitate sensitivity analysis.)

The costs of homeporting will be considered over a ten-year period using present value analysis and a discount rate of ten percent. These costs then will be compared to the costs of deployment, as discussed in Chapter IV, Section E, to determine the most viable financial alternative.

B. BACKGROUND ON ROTA

The naval base of Rota (Spanish title as used in the U.S./Spanish base agreement) is a joint Spanish-American base over which flies the Spanish flag. Groundwork for the mutual defense agreements and base construction program was laid by Admiral Forrest B. Sherman in discussions with Generalissimo Franco in 1951. Agreements signed in 1953 by the U.S. and Spanish Governments provided for an initial ten-year lease on the base sites, subject to two five-year extensions. An additional five-year treaty signed in 1976 carries the basic agreement through 1981. Major components of the base include: U. S. Naval Station with naval air facilities, port facilities, magazine area, U.S. Naval Communications Station, Fleet Weather Center, Marine Barracks, Navy Overseas Air Cargo Terminal, and Navy Fuel Depot. The harbor and airfield are joint-use facilities for U.S. and Spanish forces.

Although the U.S. activities at Rota are under U.S. control, the area encompassing the naval base is under the command of a Spanish Rear Admiral Jefe de la Base Naval de Rota, and certain areas of the base are strictly for Spanish use. The Spanish consider the U.S. naval activities as tenants and guests [Ref. 50].

C. ALLOWANCE COSTS (Ca)

As discussed in Chapter V, the cost category of allowances in the homeporting model is made up of the cost elements of Housing Allowance (HOLA), Cost of Living Allowance (COLA), and Variable Housing Allowance (VHA) paid separately or concurrently with HOLA to those members who leave their dependents in the U.S.

In this specific application of the model, homeporting an aircraft carrier and its air wing in Rota, government quarters and messing are available to all members on the ship without dependents, and therefore HOLA and COLA will not be paid to these members. The amount of HOLA, COLA, and VHA to be paid members with dependents is based on NAVFAC P-80 percentages of 62.14 percent for officers, and 31.63 percent for enlisted members moving families overseas, the respective HOLA (Table VI-1) and COLA (Table VI-2) rates for Rota, the VHA rates (Appendices H and I) for members with dependents remaining in the U.S., and the notional government housing nonavailability percentages in Rota of 25, 50, 75, and 100 percent.

Specifically, HOLA is figured by multiplying the number of married members in each paygrade times the percentage taking dependents overseas (62.14 percent for officers, and 31.63 for enlisted), times the percentage not in government quarters, times the per diem HOLA rate for each paygrade. Summing these amounts gives total HOLA per diem at each notional level, and multiplying by 30 days per month, and 12 months per year gives yearly HOLA totals of:

25%	50%	75%	100%
$59,097.60	$118,195.20	$177,292.80	$236,390.40

TABLE VI-1

HOLA FOR ROTA, SPAIN

Paygrade	Number Married	% Taking Dependents	HOLA Rate Per Diem [Ref. 51]
06	1.96	62.14	$1.20
05	53.19	62.14	1.10
04	85.72	62.14	0.95
03	142.28	62.14	0.90
02	107.71	62.14	0.75
01	20.02	62.14	0.60
W4	7.63	62.14	0.95
W3	9.54	62.14	0.85
W2	31.11	62.14	0.75
W1	0.00	62.14	0.70
E9	38.48	31.63	0.80
E8	62.60	31.63	0.80
E7	145.86	31.63	0.70
E6	424.86	31.63	0.65
E5	525.65	31.63	0.60
E4	326.50	31.63	0.55
E3	16.90	31.63	0.45
E2	7.70	31.63	0.45
E1	4.60	31.63	0.45

HOLA Rate for Rota, Spain Based on Notional Occupancy of Nongovernment Quarters

Paygrade	%25	%50	%75	%100
06	$ 2.46	$ 4.92	$ 1.08	$ 1.44
05	9.07	18.14	27.21	36.28
04	12.62	25.24	37.86	50.48
03	19.85	39.70	59.55	79.40
02	12.52	25.04	37.56	50.08
01	1.86	3.72	5.58	7.44
W4	1.12	2.24	3.36	4.48
W3	1.26	2.52	3.78	5.04
W2	3.62	7.24	10.86	14.48
W1	0.00	0.00	0.00	0.00
E9	2.46	4.92	7.38	9.84
E8	4.00	8.00	12.00	16.00
E7	32.67	65.34	98.01	130.68
E6	22.09	44.18	66.27	88.36
E5	25.23	50.46	75.69	100.92
E4	14.37	28.74	43.11	57.48
E3	0.61	1.22	1.83	2.44

Paygrade	%25	%50	%75	%100
E2	0.28	0.56	0.84	1.12
E1	0.17	0.34	0.51	0.64
	$164.16	$328.32	$492.48	$656.64
	X 30	X 30	X 30	X 30
Monthly rate	$4,924.80	$9,849.60	$14,774.40	$19,699.20
	X 12	X 12	X 12	X 12
Yearly Rate	$59,097.60	$118,195.20	$177,292.80	$236,390.40

(Note: The notional levels of 25, 50, 75, and 100 percent are percentages of the published figures previously mentioned for members taking dependents overseas.)

COLA is figured by multiplying the number of married members in each paygrade times the percentage of members taking dependents overseas, times the COLA rate for each paygrade. The COLA rate considered in Table VI-2 is for three dependents per family, rounding up the 2.73 for officers, and 2.68 for enlisted found in Appendix J. (Rounding must be done since COLA rates are for whole numbers of dependents only.) Summing these amounts gives total COLA per diem, and multiplying by 30 days per month, and 12 months per year, gives a yearly COLA total of $130,838.50. (See Table VI-2 for complete computations.)

VHA is figured by multiplying the percentage of personnel with dependents who will leave their dependents in the U.S. (37.86% for officers and 68.37 for enlisted) times the number of married personnel in each paygrade, times the VHA rate of each respective paygrade. Appendices H and I calculate the cost of VHA at various notional

TABLE VI-2

COLA FOR ROTA, SPAIN

Paygrade	Number Married	% Taking Dependents	COLA Rate Per Diem [Ref. 52]	Total COLA Per Diem
06	1.96	62.14	$0.55	$ 0.67
05	53.19	62.14	0.50	16.49
04	85.72	62.14	0.50	26.57
03	142.28	62.14	0.50	44.11
02	107.71	62.14	0.50	33.29
01	20.02	62.14	0.45	5.59
W4	7.63	62.14	0.50	2.37
W3	9.54	62.14	0.50	2.96
W2	31.11	62.14	0.50	9.64
W1	0.00	62.14	0.45	0.00
E9	38.48	31.63	0.50	5.96
E8	62.60	31.63	0.50	10.02
E7	145.86	31.63	0.50	23.34
E6	424.86	31.63	0.45	61.18
E5	525.65	31.63	0.45	75.69
E4	326.50	31.63	0.40	41.79
E3	16.90	31.63	0.40	2.16
E2	7.70	31.63	0.40	0.99
E1	4.60	31.63	0.35	0.52
				$363.44
DAILY x 1 MONTH		COLA/MONTH x 12 MONTHS		COLA/YEAR
$363.40 x 30		$10,903.20 x 12		$130,838.40

occupancy rates on nongovernment quarters. As in Chapter IV, the occupancy rates of 25, 50, 75, and 100 percent are used in determining the cost of VHA.

The yearly VHA totals at the notional occupancy rates are:

25%	50%	75%	100%
$23,412.38	$46,824.76	$70,236.47	$93,649.44

(See Appendices H and I for complete computations.)

Summing HOLA, COLA, and VHA gives the following yearly totals at the notional levels previously discussed:

25%	50%	75%	100%
$213,348.38	$295,858.36	$378,367.67	$460,878.24

See Table VI-3 for complete computations.

TABLE VI-3

ALLOWANCES AT NOTIONAL LEVELS

	25%	50%	75%	100%
HOLA	$59,098	$118,195	$177,293	$236,391
COLA	$130,838	$130,838	$130,838	$130,838
VHA	$23,412	$46,825	$70,236	$93,649
ANNUAL TOTAL:	$213,348	$295,858	$378,367	$460,878
NPV*	$1,375,454	$1,907,396	$2,439,332	$2,971,280

* Ten one-year periods at a ten percent discount rate

D. TRAVEL AND TRANSPORTATION COSTS (Ctt)

As previously discussed in Chapter V, the cost category of Travel and Transportation, (Ctt), is made up of the cost elements of member and dependent travel, transportation of privately owned vehicles, and transportation of household goods.

In this specific example of homeporting an aircraft carrier and its air wing in Rota, member travel will be accomplished initially in taking the ship and embarked air wing from Norfolk to Rota. Thus, in the initial homeport shift, only dependent travel is relevant,

along with POV and household goods transportation. When estimating the non-initial costs of Ctt over the specified ten-year period, members travel becomes relevant in that members must be relieved upon completion of tour or service.

Dependent travel is figured by multiplying the number of dependents going overseas (Appendix J), times the cost per seat for a MAC flight. Dependents will fly directly by MAC from NAS, Norfolk to Rota at a cost of $485.00 per seat. Therefore, the initial dependent transportation cost is:

2096 x $485.00 = $1,016,560.00

Section G of this chapter, Ten Year Homeporting Costs, will address the recurring costs of dependent travel over the ten-year period.

POV transportation cost is figured by multiplying the number of vehicles being shipped (Appendix K), times the average cost of transporting the vehicles overseas (Appendix L), plus the cost of transporting each vehicle to Bayonne (Appendix M), times the number of vehicles being shipped. Therefore, in the initial situation, the POV transportation cost is:

2421 x ($1075.20 + $95.50) = $2,834,264.70

Again, the recurring costs of POV transportation will be covered in Section G of this chapter.

Household goods transportation cost is figured by multiplying the number of members per paygrade that move dependents overseas, times the number of pounds shipped per paygrade to get total pounds shipped Appendix N). This total times the current rate per pound ($ .7516) gives the total cost for household goods. In the initial situation,

this total is $5,154,117.44. As before, the recurring costs of household goods transportation will be treated in Section G of this chapter. Total Ctt is calculated in Table VI-4.

TABLE VI-4

TRAVEL AND TRANSPORTATION AT NOTIONAL LEVELS

	25%	50%	75%	100%
INITIAL				
Dep Travel	$254.140	$508,280	$762,420	$1,016,560
POV	$708,566	$1,417,132	$2,125,698	$2,834,264
HHG	$1,288,529	$2,577,059	$3,865,589	$5,154,117
TOTAL	$2,251,235	$4,502,471	$6,753,707	$9,004,941
RECURRING				
Mil Travel	$1,748,910	$1,748,910	$1,748,910	$1,748,910
Dep Travel	$169,023	$338,045	$507,068	$676,090
POV	$472,378	$944,755	$1,417,133	$1,889,510
HHG	$859,020	$1,718,039	$2,577,059	$3,436,078
TOTAL (ANNUAL)	$3,249,331	$4,749,749	$6,250,170	$7,750,588
*NPV	$18,729,143	$27,377,553	$36,025,797	$44,674,389
*Nine one-year periods at a ten percent discout rate				
TOTAL NPV INITIAL AND RECURRING	$20,980,378	$31,880,024	$42,779,686	$53,679,330

E. CONSTRUCTION COSTS (Cc)

As stated earlier, construction costs (Cc) will be figured at notional levels of 25, 50, 75, and 100 percent--that is, construction

is required to support the additional loading at these respective percentages. This notional level approach to Cc is being considered rather than a "snapshot" comparison of Rota's BFRL and NAVFAC P-80 for two reasons: base loading can be very dynamic, resulting in a changing BFRL, and the notional levels provide a better medium for sensitivity analysis.

In the authors' opinion, the following Cc elements are considered pertinent: air support facilities, ship support (port) facilities, medical and dental facilities, commissary, exchange, dependent schools, chapel, housing, and recreation facilities. Each of these elements will be discussed separately. Some elements will have no effect on the cost model equation due to a given or stated value of zero; that is, no notional levels of construction are figured or considered because, in the authors' opinion, that Cc element is insignificant or not necessary.

1. Aircraft Support Facilities

Basic aircraft support facilities (e. g., tower and runways) appear to be adequate as evidenced by the presently supported P-3 and VQ squadrons. However, some additional support may be required in the form of hanger space, crew and equipment space, and administrative space [Ref. 53]. Aircraft support facilities Cc are computed in Appendix P, assuming that the notional number of aircraft in the wing is 90, the number per hanger facility is 15, and the actual spaces needed are those mentioned above. The total square footage in Appendix P is based on gross area figures found in Table 211-05 of NAVFAC P-80. The total square footage is then multiplied by the

cost per square foot of $65.00 (Appendix O), times the Overseas Adjustment Factor (OAF) of 1.3 [Ref. 54] for Spain to get the total cost of aircraft support facilities construction at the notional levels previously discussed:

25%	50%	75%	100%
$4,783,799	$9,567,513	$14,351,311	$18,910,086

See Appendix P for complete computation.

2. Ship Support Facilities

In the authors' opinion (based on surface line officer operational experience and the port directory), port facilities are adequate to service an aircraft carrier.

3. Medical and Dental Facilities

Medical and dental support construction costs are figured using dependents only as additional loading. Aircraft carriers have adequate medical and dental facilities to take care of all normal service member medical and dental needs [Ref. 55].

Dental support construction costs are figured in Appendix R by dividing the number of dependents by 700 to determine the dental officer factor, then multiplying the dental officer factor by the Dental Operating Room (DOR) factor of 2.0 [Ref. 56], to determine the number of DOR's. The square footage per DOR is obtained from table 540-10 of NAVFAC P-80.

In addition to DOR square footage, Oral Hygiene Treatment Room (OHTR) square footage also must be computed and added to the DOR square footage. OHTR square footage is calculated by dividing the number of dependents by 1500, taking the nearest whole number and entering Table 540-10 of NAVFAC P-80 to get OHTR square footage.

The total OOR and OHTR square footage times a cost of $128.00 per square foot (Appendix O), times the OAF of 1.3 gives the total cost of dental support construction at the notional levels previously discussed:

25%	50%	75%	100%
$361,920	$807,040	$951,808	$1,385,280

See Appendix R for complete computation.

Medical support construction costs are figured in Appendix Q by multiplying the number of dependents times the visit rate [Ref. 57] to get the increase in outpatient workload, which is translated into additional square footage in Table 510-10A of NAVFAC P-80. Additional inpatient square footage is calculated by the number of dependents, times the bed requirement [Ref. 58], which is translated into additional square footage in Table 510-10B of NAVFAC P-80. The total square footage then is multiplied by a cost of $85.00 per square foot (Appendix O), and the OAF of 1.3 to get total cost of medical support construction at the notional levels previously discussed:

25%	50%	75%	100%
$795,379	$1,590,648	$2,386,027	$3,158,090

See Appendix Q for complete computation.

4. Commissary

Commissary support construction costs are figured in Appendix S by taking the number of families times the average monthly purchase per family, divided by the Producer's Price Index (PPI) adjustment factor of 2.21 (found by dividing the current PPI by the 1 July 1970 PPI) to get adjusted additional sales [Ref. 59]. Entering Table

740-23 of NAVFAC P-80 with the adjusted additional sales will then give additional square footage which then is multiplied by $55.00 per square foot (Appendix O), and the OAF of 1.3 to get the commissary support construction costs at the required notional levels:

25%	50%	75%	100%
$429,000	$643,500	$1,126,125	$1,447,875

See Appendix S for complete computation.

5. Exchange

Exchange support construction costs are figured in Appendix T by calculating point values for major customers (officers, married enlisted, and dependents), and single enlisted customers, as indicated, summing the point values, and obtaining the square footage required from Table 740-01E of NAVFAC P-80. The square footage then is multiplied by $65.00 per square foot (Appendix O), times the OAF of 1.3 to get the total cost of exchange support construction at the prescribed notional levels:

25%	50%	75%	100%
$760,500	$1,166,100	$1,335,100	$1,495,650

See Appendix T for complete computation.

6. Dependent Schools

Dependent schools support construction costs are figured in Appendix U. The number of additional students is calculated by assuming .52 pupils per family for grade school (grades 1-6 and kindergarten), and .26 pupils per family for high school (grades 7-12) [Ref. 60]. Tables 730-55 and 730-60 of NAVFAC P-80 then are entered to determine square footage requirements, which then are multiplied by $62.00 per square foot (Appendix O), and the OAF of 1.3 to get

the total cost of dependent schools support construction at the notional levels:

25%	50%	75%	100%
$3,151,460	$4,175,080	$5,770,960	$6,633,380

See Appendix U for complete computations.

7. Chapel

Chapel support construction costs are figured in Appendix V by first determining the population count, which is all military personnel plus dependents age 6 and over. Table 730-83A of NAVFAC P-80 then is entered with the population count to get the number of chapel seats required. This number then is multiplied by an environmental adjustment factor (EAF) of .40 to get the adjusted number of chapel seats [Ref. 61]. Table 730-83C of NAVFAC P-80 then is entered to get the gross square footage per seat which is multiplied by the adjusted number of seats to get the square footage required. The square footage then is multiplied by $98.00 per square foot (Appendix O) times the OAF of 1.3 to get the total cost of chapel support construction at the notional levels:

25%	50%	75%	100%
$382,200	$764,400	$1,005,480	$1,199,520

See Appendix V for complete computation.

8. Housing

Additional housing construction costs will not be considered due to the ability of the local economy to absorb the overflow from base housing [Ref. 62].

9. Recreation

Additional recreation facilities construction costs also will not be considered. There are recreational facilities in Rota and on board the aircraft carrier itself. The potential cost of building another tennis court, or other similar minor construction project, is not significant when looking at total potential construction costs.

Total construction costs at notional levels are shown in Table VI-5 below:

TABLE VI-5

CONSTRUCTION AT NOTIONAL LEVELS

	25%	50%	75%	100%
ASF	$4,783,799	$9,567,513	$14,351,311	$18,910,086
MED	795,379	1,590,648	2,386,027	3,158,090
DENT	361,920	807,040	951,808	1,385,280
COMM	429,000	643,500	1,126,125	1,447,875
X-CHG	760,500	1,166,100	1,335,100	1,495,650
SCHOOLS	3,151,460	4,175,080	5,770,960	6,633,380
CHAPEL	382,200	764,400	1,005,480	1,199,520
TOTAL	$10,664,258	$18,714,281	$26,926,811	$34,229,881
TOTAL/10 AVERAGE (ANNUAL)	$1,066,425	$1,871,428	$2,692,681	$3,422,988
*NPV	$6,875,241	$12,065,096	$17,359,714	$22,068,003

*Ten one-year periods at a ten percent discount rate

F. MISCELLANEOUS COSTS (Cmm)

In the authors' opinion, there are no significant miscellaneous costs, (Cmm), as defined in Chapter V. There are no land lease or buy considerations, and the costs incurred with providing additional support personnel are considered offset by equal reductions at the previous homeport of the units.

G. TEN-YEAR HOMEPORTING COSTS

In considering the time adjustment of the homeporting costs, to be compared with the deployment costs generated in Chapter IV, costs will be divided into three categories: initial, recurring, and non-recurring (one-time) costs. Ca will be a recurring cost being considered on a yearly basis. Ctt will have an initial cost, and then will recur every three years (tour length being three years); or more realistically, one-third of the travel and transportation costs will recur every year. See Table IV-4. Cc will be a nonrecurring, one-time cost, but will be time phased over the ten-year period being considered. It is reasonable to assume that all construction will not be started nor completed in the first year. Cmm will not be considered as stated in Section F of this chapter.

Table VI-3 shows the allowance totals per year at the notional levels of 25, 50, 75, and 100 percent. It also shows the Net Present Value (NPV) of these totals based on a ten-year period at a ten percent discount rate.

Table VI-4 shows travel and transportation totals. Initial member travel is zero since virtually all members will sail with the ship from Norfolk, Virginia to Rota, Spain. Recurring member travel is

figured by assuming that one-third of the crew rotates every year, and that two trips are required per billet; that is, the relief must be sent over, and the incumbent is brought back to the U.S.

Initial dependent travel is as shown in Table VI-4, and the same rationale for members is used in figuring the recurring dependent travel; that is, one-third of the dependents rotate each year, with two trips required.

Household goods and POV transportation also have an initial cost as indicated in Table VI-4, with recurring costs using the same reasoning above.

Table VI-4 also shows the ten-year NPV for the initial costs and nine subsequent years of the recurring costs, based on a discount rate of ten percent.

Table VI-5 shows the construction costs at the notional levels of 25, 50, 75, and 100 percent. These totals are then divided by ten-years to get a yearly average construction cost at each notional level. Then the NPV is figured using ten years at the discount rate of ten percent.

Table VI-6 is the total homeporting cost of Ca, Ctt, and Cc at the notional levels while assuming zero cost for the miscellaneous category as discussed in Section F of this chapter.

In looking at Table VI-6, the total homeporting costs for Rota over a ten-year period, it is apparent that the cost category of Ctt is by far the dominant cost component. It ranges from 72 percent of the total costs at the lowest notional level (25 percent) to 68 percant of the total costs at the highest notional level (100 percent).

TABLE VI-6

TOTAL COST OF HOMEPORTING IN ROTA AT NOTIONAL LEVELS

	25%	50%	75%	100%
Ca	$1,375,454	$1,907,396	$2,439,332	$2,971,280
Ctt	$20,980,378	$31,880,024	$42,779,686	$53,679,330
Cc	$6,875,241	$12,065,096	$17,359,714	$22,068,003
Cmm	0	0	0	0
H.P. TOTAL	$29,231,073	$45,852,516	$62,578,732	$78,718,613

H. SENSITIVITY ANALYSIS

A sensitivity analysis has been built into this chapter by figuring costs at the notional levels of 25, 50, 75, and 100 percent. As stated in the thesis objectives, the cost model is intended to facilitate making decisions on deploying versus homeporting at the macro level. The authors realize that many different cost elements and categories have been summed at the various notional levels. In actual application this would not be the case. However, to aid the decisionmaking process, while facilitating the sensitivity analysis, this is the method employed by the authors.

The major cost category driving the total homeporting costs is Ctt, and the significant cost elements in this category include: dependent travel and POV and Household Goods transportation. It is possible to make the homeporting alternative more financially feasible by attempting to limit the number of dependent families going overseas; that is, make every attempt to man the ship and air wing with single members.

It also is possible to increase the tour length for members with dependents in an attempt to reduce Ctt. Obviously, this also will drive Ca and potential Cc to a commensurate lower level.

I. SUMMARY

This chapter has used the homeporting cost model developed in Chapter V to determine the homeporting costs associated with changing the homeport of an aircraft carrier and its air wing from Norfolk to Rota. The costs have been accumulated by cost element and cost category, while applying NPV analysis where applicable, to get the total ten-year financial cost of homeporting at the notional levels discussed earlier. The sensitivity analysis indicates that deploying is the financially better alternative except at the 25 percent level.

Chapter VII will conduct a similar application of the homeporting cost model for homeporting an aircraft carrier and its air wing in Naples, Italy.

VII. ANALYSIS OF HOMEPORTING IN NAPLES, ITALY

A. INTRODUCTION

In Chapter VI, an analysis of homeporting an aircraft carrier and its air wing in Rota, Spain was conducted. In this chapter, the same type of analysis will be applied to homeporting an aircraft carrier and its air wing in Naples, Italy. It is the authors' intent to build upon the assumptions delineated in Chapters V and VI.

Because the process of calculating notional costs was used in the analysis of homeporting in Rota, and because there are approximately the same amount of facilities available in Rota as in Naples, many of the cost calculations will be the same. Although the authors will describe each element of each cost category in this chapter, there will be no attempt to redescribe all the specific calculations that were made. Where there is a difference in assumptions or method of calculation, the authors will provide a full description.

The organization of Chapter VII will be the same as Chapter VI, i.e., the analysis will examine in turn the cost categories of Allowances, Travel and Transportation, and Construction. Each will be calculated at notional levels of 25, 50, 75, and 100 percent. After all calculations are completed, they will be compared to the cost of deployment as computed in Chapter IV, and by using the notional percentages, a sensitivity analysis will be conducted.

B. BACKGROUND ON NAPLES

Naples is located in the Province of Campania, 117 miles southeast of Rome. It is the second largest port, and the third largest

city in Italy. Naples has a population of well over one million. Also, it is the Headquarters of Commander in Chief, Allied Forces Southern Europe (CINCSOUTH), and the location of over 16 United States USN organizations. The senior Italian military official is the Commander in Chief, Lower Tyrrhenian Naval District (MARIDIPART) Naples, with Headquarters in the Palazzo Salerno, near Piazza Plebiscito [Ref. 63].

C. ALLOWANCE COSTS (Ca)

As discussed in Chapter V, the cost category of allowances is composed of the cost elements of Housing Allowance (HOLA), Cost of Living Allowance (COLA), and Variable Housing Allowance (VHA).

In this particular application of the model where an aircraft carrier is homeported in Naples, government quarters and messing are available on the ship for all military members. Therefore, members who either have no dependents, or who have elected not to take their dependents overseas, are not entitled to either HOLA or COLA. At the time of this writing, COLA payments were not authorized for any members in Naples, Italy. However, should COLA be authorized for Naples, only personnel with dependents overseas would be entitled to receive this allowance.

The amount of HOLA and VHA is based on NAVFAC P-80 percentages of personnel who will take their families overseas, (62.14 percent for officers, and 31.63 percent for enlisted). Table VII-1 shows the applicable HOLA rates; and Table VII-1 calculates HOLA at various notional levels of occupancy of nongovernment quarters in the same manner as in Chapter VI.

TABLE VII-1

HOLA FOR NAPLES, ITALY

Paygrade	Number Married	% Taking Dependents	HOLA Rate Per Diem [Ref. 64]
06	1.96	62.14	$4.70
05	53.19	62.14	4.25
04	85.72	62.14	3.80
03	142.28	62.14	3.45
02	107.71	62.14	3.05
01	20.02	62.14	2.45
W4	7.63	62.14	3.65
W3	9.54	62.14	3.35
W2	31.11	62.14	2.95
W1	0.00	62.14	2.75
E9	38.48	31.63	3.35
E8	62.60	31.63	3.00
E7	145.86	31.63	2.75
E6	424.86	31.63	2.55
E5	525.65	31.63	2.35
E4	326.50	31.63	2.05
E3	16.90	31.63	1.80
E2	7.70	31.63	1.80
E1	4.60	31.63	1.80

HOLA Rate for Naples, Italy Based on
Notional Occupancy of Nongovernment Quarters

Paygrade	25%	50%	75%	100%
06	$ 1.43	$ 2.86	$ 4.29	$ 5.72
05	35.12	70.24	105.36	140.47
04	50.60	101.21	151.81	202.41
03	76.26	152.51	228.77	305.02
02	51.03	102.07	153.10	204.14
01	7.62	15.24	22.86	30.48
W4	4.33	8.65	12.98	17.30
W3	4.96	9.93	14.89	19.86
W2	14.26	28.51	42.77	57.03
W1	0.00	0.00	0.00	0.00
E9	8.87	17.74	26.60	35.48
E8	14.85	29.70	44.55	59.40
E7	31.72	63.44	95.16	126.87
E6	85.67	171.34	257.01	342.68
E5	97.70	195.36	293.04	390.72
E4	52.93	105.35	158.78	211.71
E3	2.41	4.81	7.22	9.62

Paygrade	25%	50%	75%	100%
E2	$ 1.10	$ 2.19	$ 3.29	$ 4.38
E1	0.65	1.31	1.90	2.61
Total	$541.51	$1,082.96	$1,624.44	$2,165.90
	X 30	X 30	X 30	X 30
MONTHLY RATE	$16,245.30	$32,488.96	$48,733.20	$64,977.00
	X 12	X 12	X 12	X 12
YEARLY RATE	$194,943.60	$389,865.60	$584,798.40	$779,724.00

Members who leave their families in the United States, and whose families occupy nongovernment quarters are entitled to receive VHA. The monthly cost of VHA is calculated in Appendices H and I, at notional levels of 25, 50, 75, and 100 percent. Total yearly VH costs are as follows:

	25%	50%	75%	100%
Monthly VHA	$23,412.38	$46,825.76	$70,236.47	$93,649.44
	x 12	x 12	x 12	x 12
Yearly VHA	$280,948.56	$561,897.12	$840,837.12	$1,123,793.28

D. TRAVEL AND TRANSPORTATION COSTS (Ctt)

As described in Chapter V, the cost category of Travel and Transportation is composed of the cost elements of member travel, and dependent travel, transportation of privately owned vehicles, and transportation of household goods.

Because the military members will be transported via the carrier, in the initial shift of homeport the initial cost for member travel will be zero. Summing the costs of travel and transportation over a ten-year period, member travel becomes a relevant cost. This factor will be discussed fully in Section G of this chapter.

Dependent travel cost will be based on the price per seat for a Military Airlift Command (MAC) flight from Norfolk, Virginia to Naples. Presently the price is $625.00, [Ref. 65]. The cost of dependent travel in the initial condition is calculated by multiplying the number of dependents (Appendix J) times the price per seat:

2096 x $625.00 = $1,310,000

The recurring cost of dependent travel over ten years is examined in Section G of this chapter.

POV transportation is calculated by multiplying the number of POV's (Appendix K) times the overseas transportation cost per POV (Appendix L), and the travel cost of the member to take the POV to the terminal for overseas shipment [Refs. 66 and 67]. As in Chapter VI, the costs are based on moving a POV from Norfolk to Bayonne, New Jersey for further shipment to Naples. POV transportation cost is:

2421 x ($1075.20 + $95.50) = $2,834,264.70

Again, this represents the initial cost; recurring costs are determined in Section G.

Household goods transportation cost is computed by multiplying the sum of the number of unit personnel per paygrade, times the number of pounds shipped per paygrade (Appendix N), times the current rate per pound of $0.6795 [Ref. 68]:

6,358,171.8 pounds x $0.6795/pound - $4,660,128.00

This represents the initial cost. The recurring costs are computed in Section G of this chapter.

E. CONSTRUCTION COSTS (Cc)

The methodology for calculating construction is fully described in Chapter VI. The assumptions that applied in Chapter VI also apply to Chapter VII. As a short review, the authors considered the following cost elements as pertinent: air support facilities, ship support facilities, medical and dental facilities, commissary, exchange, dependent schools, chapel, housing, and recreation. As in Chapter VI, each cost element will be discussed separately. However, the exact method of calculation of each cost will not be reviewed. Also, because the authors used a notional level approach to Cc, the costs computed in the respective appendices are the same for both Rota and Naples.

1. Aircraft Support Facilities

Current aircraft support facilities are provided at Naples at Capodichino Airfield located three miles northeast of Naples. It also serves as a civilian airport. It is operated by the Italian Air Force, and jointly used by the USN for logistics purposes [Ref. 69]. To use this airfield for carrier based aircraft, the authors have determined that additional construction of hanger space, crew and equipment space, and administrative space will be necessary. The following cost is calculated in Appendix P:

25%	50%	75%	100%
$4,783,799	$9,567,513	$14,351,311	$18,910,086

2. Ship Support Facilities

The port area of Naples consists of 3300 acres of land area and 6900 acres of water areas. There are four waterbreaks totalling 12,582 feet in length, and 46,650 feet of quay walls, with 70 distinct

mooring berths of which about 50 can take ships of large tonnage. There are two seaway entrances to the port, the eastern being 330 yards wide, and the western being 220 yards wide. Fuel, lube oil, and diesel oil facilities are available at several piers [Ref. 70].

In the authors' opinion, based on line officer operational experience and the port directory for Naples, the port facilities are more than adequate to service an aircraft carrier.

3. Medical and Dental Facilities

Aircraft carriers have more than adequate medical and dental facilities to take care of all normal needs of the embarked service personnel. There are medical and dental services currently available in Naples for dependents at the Naval Regional Medical Center (NRMC). NRMC provides the following specialty care: general surgery, internal medicine, opthalmology, orthopedics, pediatrics, aviation (flight physicals), psychiatry, OB/GYN, radiology, and pathology. There also is an alcohol rehabilitation unit at the same location. NRMC has approximately 80 operating beds available. However, additional construction will be needed to provide full support for dependents. The following medical construction cost data is from Appendix Q:

25%	50%	75%	100%
$795,379	$1,590,648	$2,386,027	$3,158,090

The U.S. Navy Regional Dental Center (NRDC) provides the full spectrum of dental care. Again, the authors determined that additional construction will be necessary to support fully the additional patient loading. The dental construction cost below are from Appendix R:

25%	50%	75%	100%
$361,920	$807.040	$951,808	$1,385,280

4. Commissary

In the authors' opinion, commissary facilities at Naples need expanding to support the additional loading. The commissary construction costs are calculated in Appendix S:

25%	50%	75%	100%
$429,000	$643,500	$1,126,125	$1,447,875

5. Exchange

Exchange facilities also will need to be increased to support additional loading. Appendix T shows the notional levels of construction costs:

25%	50%	75%	100%
$760,500	$1,166,100	$1,335,100	$1,495,650

6. Dependent Schools

Costs for notional construction levels for dependent schools are computed in Appendix U. These costs include construction of general classrooms, special classrooms, gymnasium, library, and multipurpose kitchen. The costs are:

25%	50%	75%	100%
$3,151,460	$4,175,080	$5,770,960	$6,633,380

7. Chapel

The costs for notional levels of chapel construction is in Appendix V. There are some spaces aboard the aircraft carrier that are used to conduct religious services, however, these spaces are limited in size and could not support any dependent loading. The

following are the costs, at notional levels, of chapel construction:

25%	50%	75%	100%
$382,200	$764,400	$1,005,480	$1,199,520

8. Housing

Additional housing construction will not be considered due to the ability of the local economy to absorb the overflow from base housing.

9. Recreation

Additional recreational facilities construction cost also will not be considered. There are some facilities onboard the carrier, and there also are many types of recreation available in the Naples area. If any additional facilities were needed, the cost of such construction would be relatively insignificant compared to the total construction cost.

F. MISCELLANEOUS COSTS (Cm)

In the authors' opinion, there are no significant miscellaneous costs as defined in Chapter V. For Naples, as in the case for Rota, there are no land lease/buy considerations, and the cost of additional support personnel are considered by the authors to be offset by equal reductions at the previous homeport of the carrier.

G. TEN YEAR HOMEPORTING COSTS

The summing of homeporting costs over ten years will be conducted in the same manner as in Chapter VI. Each of the three cost categories will be calculated, and a net present value (NPV) of 10 percent

will be applied. Again, cost will be divided into three types: initial, nonrecurring, and recurring.

Table VII-2 shows the allowance totals per year at the notional levels of 25, 50, 75, and 100 percent. The NPV of the totals is based on a ten-year period at a 10 percent discount rate.

TABLE VII-2

ALLOWANCES AT NOTIONAL LEVELS

	25%	50%	75%	100%
HOLA	$194,944	$389,866	$584, 798	$779,724
COLA	0	0	0	0
VHA	$280,949	$561,897	$840,838	$1,903,507
Total	$475,893	$951,763	$1,425,636	$1,903,507
NPV*	$3,068,082	$6,136,016	$9,191,075	$12,271,909

*Ten percent discount for 10 years

Table VII-3 shows the travel and transportation totals. The initial member travel will be zero since virtually all members will sail with the ship from Norfolk to Naples. Dependent travel will have an initial cost; then it will have a yearly recurring cost. The recurring costs will be discounted by 10 percent per year. Travel and transportation will be calculated at notional levels of 25, 50, 75 and 100 percent except for member travel which is calculated at 100 percent.

Table VII-4 shows the construction costs at 25, 50, 75, and 100 percent. These totals are divided by ten to get a notional average

TABLE VII-3

TRAVEL AND TRANSPORTATION AT NOTIONAL LEVELS

	25%	50%	75%	100%
Initial				
Dep. Trav.	327,500	655,000	982,500	1,310,000
POV Trans.	708,566	1,417,132	2,125,698	2,834,264
*HHG Trans.	1,165,032	2,330,064	3,495,096	4,660,128
Total Initial	2,201,098	4,402,196	6,603,294	8,804,392
Recurring				
**Mem. Trav.	2,265,438	2,265,438	2,265,438	2,265,438
Dep. Trav.	219,425	438,850	658,275	877,700
POV Trans.	472,378	944,755	1,417,133	1,889,510
HHG Trans.	780,581	1,561,143	2,341,714	3,122,286
Total Recurring	3,737,822	5,210,186	6,682,560	8,154,934
NPV of Total Recurring	21,544,806	30,031,512	38,518,275	47,005,039
FINAL TOTAL	23,745,904	34,433,708	45,121,569	55,809,431

NPV-Ten percent discount per year for nine years

*HHG-Household goods

**Member travel cannot be reduced below 100 percent

yearly construction cost at each level. The discount rate of ten percent is applied over the ten years.

TABLE VII-4

CONSTRUCTION AT NOTIONAL LEVELS

	25%	50%	75%	100%
*ASF	$4,783,799	$9,567,513	$14,351,311	$18,910,086
Medical	795,379	1,590,648	2,386,027	3,158,090
Dental	361,920	807,040	951,808	1,385,280
Commissary	429,000	643,500	1,126,125	1,447,875
Exchange	760,500	1,166,100	1,335,100	1,495,650
Schools	3,151,460	4,175,080	5,770,960	6,633,380
Chapel	382,200	764,400	1,005,480	1,199,520
TOTAL	$10,664,258	$18,714,281	$26,926,811	$34,229,881
TOTAL/10 AVG ANNUAL	$1,066,425	$1,871,428	$2,692,681	$3,422,988
NPV	$6,875,241	$12,065,096	$17,359,714	$22,068,003

NPV = Ten percent discount per year for ten years

*ASF = Air Support Facilities

Table VII-5 is the total of the homeporting costs over a ten-year period. By examining the costs in Table VII-5, it can be seen that Ctt varies from 70 percent of the total cost at the notional level of 25 percent to 62 percent of the total cost at the notional level of 100 percent. Therefore, as in the case with Rota, the cost category

of Ctt for Naples is the major factor in determining the cost of overseas homeporting. Using these figures, a sensitivity analysis will be conducted in the following section.

TABLE VII-5

TOTAL COST OF HOMEPORTING IN NAPLES AT NOTIONAL LEVELS

	25%	50%	75%	100%
Ca	$3,068,082	$6,136,016	$9,191,075	$12,271,909
Ctt	$23,745,904	$34,433,708	$45,121,569	$55,809,431
Cc	$6,875,241	$12,065,096	$17,359,714	$22,068,003
Cmm	0	0	0	0
TOTAL	$33,689,227	$52,634,820	$71,672,358	$90,149,343

Ca = Allowance Cost

Ctt = Travel and Transportation Cost

Cc = Construction Cost

Cmm = Miscellaneous Cost

H. SENSITIVITY ANALYSIS

As in Chapter VI, a sensitivity analysis has been built into this chapter. Again, as in the case with Rota, the homeporting alternative becomes financially feasible only at the 25 percent level due to the high cost of travel and transportation, specifically the high cost of transporting household goods and POVs, and dependent travel. Only by placing some artificial limit on the number of families traveling overseas could homeporting in Naples become the most financially attractive alternative.

I. SUMMARY

In this chapter, the cost of homeporting an aircraft carrier and its air wing in Naples, Italy was calculated and compared to the cost of deployment calculated in Chapter IV. Sensistivity analysis revealed that the high cost of dependent travel, and transportation of POVs and household goods caused the homeporting alternative to be financially undesireable except at the 25 percent level, i.e., the level at which only 25 percent of the projected number of families would actually move overseas.

In any consideration of a shift in homeport more than the financial aspect must be examined. In Chapter VIII, nonquantifiables such as retention, training, and political relations are explored.

VIII. NONQUANTIFIABLE AND UNCERTAINTY FACTORS

A. INTRODUCTION

The previous five chapters have dealt with the development and application of the deployment and homeporting cost models to determine tangible financial costs. Each alternative (deployment and homeporting) has been estimated, and a comparison of the deployment costs in Chapter IV, with homeporting costs in Chapters VI and VII, lead one to conclude that the cost of homeporting is significantly greater than the cost of deployment, except in the case in which minimum dependent travel and transportation and other minimum support costs occur. However, the financial costs or quantifiable factors, as addressed in this thesis, do not paint the complete picture of the situation. In most any cost analysis there are factors which the author(s) cannot express by some method of financial measurement. This chapter will attempt to address some of these nonquantifiable and uncertainty factors.

B. NONQUANTIFIABLE FACTORS

The final analysis of deployment versus homeporting cannot be put into proper perspective without first considering other areas that have a significant effect on the alternatives. Nonquantifiable factors, or factors which are difficult or even impossible to assign a dollar value to, will be the first nonfinancial aspect to be reviewed. From the authors' point of view, the two most important nonquantifiable factors are retention and training.

1. Retention

Retention continues to be a major problem in the United States Navy. The Chief of Naval Operations (CNO), Admiral Thomas B. Hayward, has stated repeatedly that increased retention, both officer and enlisted, is one of his primary objectives [Ref. 71]. In view of this, the USN has undertaken a program to determine the reasons why service members are leaving the United States Navy. The primary vehicle being used to determine the reasons is the Separation Questionnaire being administered to both officer and enlisted personnel as required by the CNO in his instruction OPNAVINST 1040.7 of 22 December 1980. The latest results obtained indicate that family separation is the number one reason for officer separation, and the number two reason for enlisted separation [Ref. 72].

As discussed in Section D of Chapter II, homeporting an aircraft carrier overseas will reduce the number of days out of homeport for that aircraft carrier. In addition, the six to nine months of family separation due to deployment will be eliminated for that aircraft carrier overseas, and the attendant decrease in family separation can increase retention. This could result in a cost reduction to the USN overall, a reduction beyond the scope of this study.

2. Training

Training of personnel is inherently an important factor in unit operational readiness, improvement of which is another key objective of the CNO [Ref. 73]. How training, and therefore operational readiness, will be affected by homeporting an aircraft carrier overseas is difficult to ascertain. Most personnel, both officer and

enlisted, are trained enroute to their new duty station, in this case, the aircraft carrier and air wing. However, it is reasonable to assume that during an individual's tour of duty, he or she may need additional training to assume a different job (one of greater responsibility requiring more knowledge, or one of similar responsibility in another functional area). How many personnel will require additional training is a function of the command; that is, how many will the command desire to move to different jobs, and how many will the command want to receive the desired additional training. The point is, additional travel and allowances would be required to fund this training since most, if not all, would be conducted in the U.S. at various commands. This would be an additional nonquantifiable cost.

However, on the other hand, the authors feel that the cohesiveness between the aircraft carrier and its air wing developed through continuous operations together, and the elimination of the learning curve phenomenon experienced by newly deployed units, should enhance operational readiness and in fact reduce some training requirements. Therefore, it is difficult, if not impossible, to quantify this factor. In the authors' opinion though, the homeporting alternative would enhance operational readiness and reduce the overall training requirements, adding to an overall cost reduction to the USN.

C. UNCERTAINTY FACTORS

Factors that need to be considered in the analysis that are uncertain in their own nature include the political climate of the host country; the changing role of the U.S. in NATO; the effects of

the international balance of payments with increased expenditures in the host country; and the overall Middle East situation.

Certainly, a key factor, if not the most important or first one to be considered, is the political climate of the host country. It is most logical, in spite of strategic location, to choose a country that is both pro-U.S. and politically stable. To choose a country that is not so, initiate the homeport shift, incur the initial costs of travel and transportation, and commence any required or desired construction, only to be thrown out by a new unfriendly government would be a tremendous waste of resources. This also would cause a loss of face to the U.S., and unnecessary turmoil for the members and dependents of the unit(s) involved. A good example of this is the attempt to homeport an aircraft carrier in Athens, Greece, which was aborted in 1974 due to the Cyprus conflict.

The heightened Middle East tensions, and the Reagan administration's stated support of NATO make increased demands on the carrier forces of the USN a distinct possibility. As stated in Chapter II, U.S. carrier forces are already stretched to the limit in regard to operating schedules and deployments. The homeporting of an aircraft carrier and its air wing in the Mediterranean Sea could help alleviate some of this demand in the near future.

D. SUMMARY

The nonquantifiable factors of retention and training both appear to lean in favor of the homeporting alternative. If past experience can be used as an indicator, retention in U.S.S. Midway (CV-41), homeported in Japan, is higher than the fleet average [Ref. 74],

then increased retention could be expected in an aircraft carrier and its air wing homeported in the Mediterranean Sea. And, as stated before, increased retention results in an overall cost reduction to the USN.

Training is more difficult to assess, but the enhanced operational readiness induced by increased cohesiveness between the aircraft carrier and its air wing would appear to offset additional training costs. In addition, retention and training are related; increased retention requires fewer personnel replacements, also diminishing training costs.

The uncertainty factors mentioned above also lean toward the homeporting alternative, providing a ready asset in the Mediterranean Sea to help filfill NATO commitment and ease the carrier deployment burden.

IX. CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

In this thesis, the authors have developed a cost model that compares the differential costs of deployment overseas from the United States to that of homeporting overseas. Although it was the authors' primary intention to use the model for evaluating the specific case of homeporting an aircraft carrier overseas, the authors included many factors in the model that would allow the model to be used in comparing the differential costs of deployment versus homeporting of any military unit.

By using an analytical technique which included calculating the costs of deployment and homeporting at various notional levels, the authors built in a sensitivity analysis which facilitated the comparison of the final costs of each alternative.

In this chapter the authors will discuss their conclusions based on the financial and nonfinancial (nonquantifiable and uncertainty) factors presented in all previous chapters. Also, in Section C of this chapter, the authors will present several areas where further research should be conducted.

B. CONCLUSIONS

Because the authors are considering that the level of effectiveness of a deployed carrier is the same as a carrier homeported overseas, the decision to be made via the cost effective analysis is based on the cost data only.

The authors determined that the discounted cost of deployment for ten years would be:

Least Cost	Most Likely	Most Cost
$36,106,036	$36,918,329	$43,005,435

In chapters VI and VII, the authors determined the costs of homeporting. Again a discount was applied to the costs projected over ten years. The two overseas ports evaluated were: Rota, Spain, and Naples, Italy. These costs are:

Rota

25%	50%	75%	100%
$29,231,073	$45,852,516	$62,578,732	$78,718,613

Naples

25%	50%	75%	100%
$33,689,227	$52,634,820	$71,672,358	$90,149,343

As can be seen, the only level in which homeporting is financially feasible in either Rota or Naples is 25%.

From an examination of Table VI-6 and Table VII-5 the high costs of transportation of household goods, transportation of POVs, and dependent travel are readily apparent. These costs, which represent well over half the cost of homeporting, preclude homeporting overseas unless the number of dependent families going overseas was held to an artificially low level; that is, approximately one quarter of the number that would normally be expected to go overseas.

Any restriction in the number of families that may accompany the service member overseas may cause retention of the affected unit to fall, which could be ill-afforded by the USN at a time when high

retention is needed. Therefore, other alternatives must be considered. One alternative is to man the carrier and the air wing with as many single personnel as possible. This method would reduce the costs of homeporting overseas, but the feasibility and consequences are unknowns. Another alternative would be to increase the tour length. Here again, the effect on retention would have to be determined.

The authors are of the opinion that if the homeporting alternative is desired, more than the financial considerations presented so far will have to be evaluated as presented in Chapter III.

C. RECOMMENDATIONS

At the present, the authors recommend against homeporting overseas strictly on financial grounds. However, the authors believe that there are several areas of research that could influence the homeporting decision by quantifying some of the hidden costs which are inherent when considering such a complex problem.

The authors recommend further research in the following areas:

1. Determine the feasibility and consequences of manning an aircraft carrier and its air wing with as many single personnel as possible.

2. Determine: a), if there would be higher retention due to homeporting overseas, and b), if the cost savings of the increased retention is sufficient to offset the high travel and transportation costs.

3. Determine if the level of training overseas is significantly different as to result in any cost savings, and/or any changes in the level of effectiveness.

4. Study alternative means of transporting personnel (both dependents and members), household goods, and POVs that could result in significant cost savings.

5. Determine if it is feasible and cost effective to man the carrier and its air wing with a mix of NATO allied personnel and USN personnel. Also consider a mix of NATO aircraft.

It is the authors' opinion that any or all of these studies could weigh heavily on the decision to homeport overseas.

D. SUMMARY

In this chapter the authors have reviewed the differential costs associated with deployment and homeporting overseas. It is their conclusion that strictly on financial merit alone, the homeporting alternative is not practical. However, the authors also believe that it is necessary to conduct further research in selected areas, as delineated in Section C of this chapter, before final judgment can be made.

As stated earlier in this thesis, the authors constructed the cost model to include the feature of universality; that is, the model can be used in comparing the cost of homeporting versus the cost of deploying for any military unit, regardless of the branch of service or mission performed. The authors are of the belief that this model is an excellent analytical tool with which each branch of the service could examine, fram a macro viewpoint, the cost effectiveness of deploying or overseas homeporting of its units.

APPENDIX A

SECNAVINST 7000.14A
14 Mar 1973
NUMBER 7041.3
DATE October 18, 1972

Department of Defense Instruction

ASD(C)

SUBJECT Economic Analysis and Program Evaluation for Resource Management

Refs: (a) DoD Instruction 7041.3, "Economic Analysis of Proposed Department of Defense Investments," February 26, 1969 (hereby cancelled)
(b) Presidential Memorandum to the Heads of Departments and Agencies, "Program Evaluation," May 25, 1970
(c) Office of Management and Budget Circular No. A-94, "Discount rates to be used in evaluating time-distributed costs and benefits," March 27, 1972
(d) Office of Management and Budget Circular No. A-11, (Revised), "Preparation and Submission of Annual Budget Estimates," June 21, 1971
(e) through (q) are listed in Enclosure 1

I. PURPOSE AND OBJECTIVES

This Instruction:

A. Reissues reference (a) to incorporate amendments required by references (b), (c), and (d).

B. Outlines policy guidance and establishes a framework for consistent application of:

1. Economic analysis on proposed programs, projects and activities, and

2. Program evaluations of on-going activities.

The policy guidance contained in this Instruction should be applied in comprehensive and continuous management reviews of the cost and effectiveness of resource requirements for both proposed and on-going activities. Such management reviews should include the use of economic analyses and program evaluations, as appropriate. These concepts are defined in Section IV. below and are types of management reviews and priority improvement projects called for by reference (e).

C. Establishes the Defense Economic Analysis Council, under the staff supervision of the Assistant Secretary of Defense (Comptroller).

II. CANCELLATION

Reference (a) is superseded and cancelled.

B. Program Evaluation is economic analysis of on-going actions to determine how best to improve an approved program/project based on actual performance. Program evaluation studies entail a comparison of actual performance with the approved program/project.

Note: Economic analysis and program evaluation have different purposes. The former concept is designed to assist a manager in identifying the best new programs and projects to be adopted. The latter focuses on approved programs and projects to insure that established goals and objectives are being attained in the most cost-effective manner.

V. POLICY

A. The concepts of economic analysis and program evaluation constitute an integral part of the Planning, Programming, and Budgeting System of the Department of Defense (reference (f)) and have implications at all levels of authority (e.g., Headquarters, Command, and installation level). Automatic submission of analyses at the level of the Office of the Secretary of Defense (OSD) is not intended by the requirements of this Instruction. Review of analyses at the OSD level will be made on a selective basis considering time and staffing constraints as well as existing program review requirements. However, project officers and managers should be prepared to demonstrate the cost effectiveness of budget proposals and to submit detailed analyses in support of budget estimates, as provided in reference (g).

B. In developing and justifying resource requirements:

1. An economic analysis is required for proposals which involve a choice or trade-off between two or more options even when one of the options is to maintain the status quo or to do nothing. Economic analysis will be applied as appropriate in making these relative comparisons or trade-offs among alternatives considering cost, schedule, and performance in order to support:

a. Commitment of resources to proposed new programs/projects when funding is for the first time required in the five year-period covered by the current fiscal guidance.

into program/project authorizations and mission statements in the case of on-going activities. Output information will be utilized in an economic analysis by matching it with cost data (reference (h)).

E. A complete economic analysis/program evaluation contains the features outlined in Enclosure 2.

VI. THE DEFENSE ECONOMIC ANALYSIS COUNCIL

A. The Defense Economic Analysis Council will serve in an advisory capacity to the Assistant Secretary of Defense (Comptroller). The Council will encourage DoD-wide application of the concepts contained in this Instruction in the planning, programming, budgeting, and evaluation processes. In this way it will also serve to strengthen analytical capabilities throughout the Department of Defense.

B. The various offices of the Secretary of Defense, the Military Departments and Defense Agencies will appoint competent representatives to the Council. Individuals designated as Points of Contact for Output Information in accordance with reference (h) are members of the Council.

C. A Chairman will be appointed annually by the Assistant Secretary of Defense (Comptroller) based on recommendations from the Council members.

D. Council members will be responsible for advising the OASD(C) and their respective Departments and Agencies on matters relating to:

1. Policies and procedures with regard to the use of economic analysis/program evaluation.

2. Application of economic analysis in the planning, programming, budgeting, evaluation process and other decision-making processes of the Department of Defense.

3. Techniques and methodology for justifying and supporting resource consumption decisions.

4. Educational programs for fostering an understanding of techniques of analysis and enhancing their usefulness to managers and operations personnel.

REFERENCES

(e) DoD Directive 5010.28, "Department of Defense Management Improvement Program," January 30, 1971
(f) DoD Instruction 7045.7, "The Planning, Programming, and Budgeting System," October 29, 1969
(g) DoD 7110-1-M, "Department of Defense Budget Guidance Manual," July 1, 1971, established by DoD Instruction 7110.1, August 23, 1968
(h) DoD Instruction 7045.11, "Improvement and Use of Output Information in the DoD Planning, Programming, and Budgeting System," December 17, 1970
(i) Office of Management and Budget Circular No. A-104, "Comparative cost analysis for decisions to lease or purchase general purpose real property," June 14, 1972
(j) DoD Instruction 4100.33, "Commercial or Industrial Activities - Operation of," July 16, 1971
(k) DoD Directive 5000.1, "Acquisition of Major Defense Systems," July 13, 1971
(l) DoD Directive 7250.5, "Reprogramming of Appropriated Funds," May 21, 1970
(m) DoD Instruction 7250.10, "Implementation of Reprogramming of Appropriated Funds," April 1, 1971
(n) DoD Instruction 4215.14, "Replacement of Machine Tools," September 10, 1957
(o) DoD Directive 4275.5, "Industrial Facility Expansion and Replacement," December 3, 1971
(p) DoD Directive 4105.55, "Selection and Acquisition of Automatic Data Processing Resources," May 19, 1972
(q) DoD Instruction 5010.27, "Management of Automated Data Systems Development," November 9, 1971

a. When comparing two or more program/projects, or two or more ways to accomplish a particular program/project, indicate which approach is being evaluated by an identifying number, letter, or special identification.

b. A distinction between "present" and "proposed" should be made. The "present" alternative seeks to identify the level of costs and effectiveness that would accrue without changing the status quo while the "proposed" alternative presents the costs undertaken. If there is a cost savings, it will be the difference between the discounted recurring cost of a currently approved program/project and the discounted recurring cost of each "proposed alternative" plus the present value of savings to be realized by the elimination of modification or refurbishment costs for the "present" alternative.

c. Where alternative methods of financing are available, a comparative cost analysis should be prepared to show that the lowest cost method of acquisition has been considered.

4. Cost Analysis. All resources required to achieve stated objectives are to be shown in the analysis. Few specific suggestions can be made as to what cost elements should be included in a comparative cost study because of the diversity of problems encountered. In general, costs of each alternative will be exhaustive, and cost estimates will be mutually exclusive to avoid double counting. Life-cycle cost estimates (LCCE) will be included for research and development, investment and operations for all program alternatives when feasible. Life-cycle costs include all anticipated expenditures directly or indirectly associated with an alternative. They should be listed by the year in which they are expected to be incurred. Costs which have already been incurred at the time an analysis is made are "sunk costs" and should not be included in the comparison of alternatives. The LCCE provides a baseline which will be used to evaluate performance as needed.

a. Costs

(1) Research and Development (R&D). All costs for Research and Development (identified by year).

(2) Investment Costs. Costs associated with the acquisition of equipment, real property, nonrecurring services, nonrecurring operations and maintenance (start-up) costs, and other one-time investment costs. Investment costs need not all occur in a single year. They include:

(a) The cost of rehabilitation, modification or addition of land, buildings, machinery and equipment.

(b) The costs of rehabilitation, modification or other capital items such as furnishings and fittings

2 If, however, the terminal or residual value is expected to be significant (e.g., ADPE, precision machine tools), this value will be included in the cost analysis. Residual values may be important when considering projects with varying life cycles. (See paragraph c.(2)(b) below.) The explicit assumptions used in the derivation of all terminal or residual values must also be provided.

3 Include the terminal value of working capital as an offset to total project costs.

4 In many DoD Investments, the proposed purchase of a new piece of equipment or facility eliminates the need for an existing piece of equipment or facility. If property is sold, the proceeds benefit the Government because they are included in Miscellaneous Receipts by the Treasury Department. If property is redistributed to some other Federal agency, that agency is benefited even though there is never any reimbursement or cash-flow to the agency which controlled the property initially. The fair market value of these assets may be determined by sale price, scrap value, or alternative use value.

5 Residual values of general purpose real property should be determined in accordance with reference (i) which prescribed special obsolescence and appreciation factors.

(3) Recurring (Operations) Costs. This item of cost includes personnel, material consumed in use, operating, overhead, the costs of support services required on an annual basis and any other recurring costs.

(a) Personnel. This category includes personnel costs (civilian and military) and employee benefits.

1 Civilian Personnel Services

(a) The cost of civilian personnel services involved directly in the work to be performed. The cost of civilian personnel paid at annual rates will be gross pay in current pay tables, plus the Government's contribution for civilian retirement, disability, health, life insurance and where applicable, social security programs.

(b) If labor costs are determined on the basis of direct labor hours applied, the civilian pay rate should be increased to cover leave and other benefits of civilian pay such as the average cost of sick leave taken and annual, holiday and other paid leave accruals, plus the average Government contributions for other benefits.

large whereas operating costs may be small during the first year or two and increase during the middle and later years of a project. Recognition of the timing of cash-flows and discounting both the differential investment and recurring costs of the alternatives to their present value is accomplished through the use of discounting. After estimates of cash-flows have been developed for each alternative, the present value (discounting) technique will be used to discount costs and benefits as required by reference (c).

(1) Specifically exempted from the requirement to use discounting are:

(a) Decisions concerning water resource projects.

(b) Decisions concerning the acquisition of commercial-type services by Government or contractor operation, guidance for which is reference (j).

(c) Proposed programs/projects which if adopted would commit the Department of Defense to a series of measurable costs which in aggregate would not extend over three years, or which result in a series of cash benefits that do not extend over three years from the inception date.

(d) Program evaluation studies which deal only with historical costs or contain no cost comparisons.

(2) Interest will be treated as a cost which is related to all Government expenditures, regardless of whether there are revenues or income by way of special taxes for a project to be self-supporting. This policy is based on the premise that no public investment should be undertaken without explicitly considering the alternative use of the funds which it absorbs or displaces.

(a) One way for the Department of Defense to assure this is to adopt a discount rate policy which reflects private sector investment opportunities foregone. The discount rate reflects the preference for current and future money sacrifices that the public exhibits in non-Government transactions. A 10 percent rate is considered to be the most representative overall rate at the present time. Thus, future financial benefits and costs will be discounted at an annual rate of 10 percent as prescribed by reference (c).

(b) Discount rate policy of 7 percent is prescribed by reference (i) for general purpose real property. When a constant dollar price deflator of 2 to 3 percent is applied, the effective discount rate is 9 to 10 percent.

unequal lives. A second way to treat alternatives with unequal economic lives is to base the time period of the analysis on the economic life of the asset with the shorter time period. In this case the residual value of the asset with the longer economic life must be considered in the computation of the costs of that alternative.

(3) The economic life will probably differ from physical or technological life and if it is better data, should be used in lieu of depreciation guidelines established by the Internal Revenue Service, the Federal Communications Commission and similar regulatory bodies. Also, if the economic life of a project is expected to differ from the expected physical or technological life, the economic life must be used for purposes of the analysis. Since economic life is a key variable, it is important to make the best possible determination.

(4) Alternatives will be compared on the basis of the time period of stable program use or operation. In the case of lease-purchase or purchase-contract, if such period is greater than the contract term permitted under authority for long-term leasing, the analysis should assume renewal of the lease at the last constant dollar payment.

(5) The economic life will vary by type of weapon or support system. In general, the period of usage will be the basis for determining economic life and will be measured against a stipulated level of threat, or represent the period during which a given mission or function is required or can be supported.

(6) Cost projections based on a reasonable extension of the funding level of the Five Year Defense Program (FYDP), rather than maximum plant capacity or equipment utilization, constitute the base considered most realistic for comparing alternatives. The economic life for the alternatives and the program established for the Five Year Defense Program (FYDP) will normally be used as a basis for comparative cost studies. Estimates for resource utilization beyond the FYDP and within the economic lives of the alternatives considered are to be based on an extension of the FYDP.

d. Treatment of Inflation. Estimates for inflation continuing into future years are often important in conducting time-phased trade-off studies. When this is the case, program/project analyses and evaluations will specifically consider inflation. To detect the effect of changes in the purchasing power of a dollar, both constant dollars (without inflation) and current dollars (with inflation) will be considered in analyzing and evaluating alternatives.

(d) There are three methods which can be used to calculate program/project costs adjusted for inflation. Method 1 below, is preferred because it portrays changes in real prices exclusive of the effects of discounting.

1 Inflate the cost streams first then introduce the discount rate.

2 Discount the cost streams first then introduce inflation.

3 Apply a joint discount/inflation rate in a single calculation.

Regardless of the order of introduction of the inflation rate (methods 1, 2, or 3) the result after all calculations will be the same. Therefore, when an inflation rate is employed with a 10 percent discount rate, the order of the calculations is not important.

5. Benefit/Output Analysis. An analysis will identify the outputs of each alternative: benefits, utility, effectiveness, performance, and work measures (reference (h)).

a. Economic Analysis. Provide estimates for all benefits, outputs, or effectiveness expected to be received as a result of undertaking a program/project.

b. Program Evaluations. Identify indicators of actual performance and where feasible make comparisons with outputs from related on-going programs.

c. Output measures shall be expressed quantitatively whenever possible. Insofar as practical this information shall be capable of historical accumulation, and must be auditable and relatable to significant organizational missions and functions, to relevant environmental impacts, and to resources consumed or required. The period of time for which these benefits accrue is a function of the economic life of the project in question.

d. Important non-quantifiable benefits, e.g., health, safety, or security will also be specifically identified in the analysis, if pertinent to a decision.

e. The following step-by-step procedure can be used to greatly facilitate dealing with the output measurement problem.

(1) Step I - Identify all relevant outputs. Government programs/projects have at least one and often two or more objectives. These objectives may be prescribed by law,

(2) Productivity indexes are to be based on the ratio of total output to resource output.

(3) Output measures are to be based on the volume of product or services produced and should take into account the relative importance of any differences in the products or services.

(4) Whenever any trends are significantly different than original estimates, the analysis shall deal with the reasons therefore.

6. Ranking Alternatives. In general, economic analysis/program evaluation will be used by managers as an input in selecting the most cost-effective alternative.

a. Each organization responsible for program/project management will establish priorities and identify its own preferred alternatives by making comparisons of the costs and outputs of proposed and on-going programs/projects.

b. In the case of on-going programs/projects comparisons will be made of actual performance against planned performance to insure that programs/projects, once they are approved, continue to be cost-effective. Variances from program/project estimates, identified as a result of these comparisons, provide managers with indicators which enable them to evaluate performance and provide a factual basis for revising or reordering priorities.

c. Criteria for determining and ranking the cost-effective alternatives is stated below.

(1) Least Cost Alternatives - When alternatives for achieving a given mission/objective have the same level of benefits, the alternative with the lowest discounted cost or lowest uniform annual cost should be preferred.

(2) Alternative with Maximum Benefits - As a rule, the best criterion, in cases where benefits and outputs are a determining factor, is to prefer that alternative which yields the greatest benefits or effectiveness for a given level of cost (discounted). In situations where it is difficult to quantify benefits and measures of effectiveness, it is important to provide as much useful information as possible to enable a decision to be made as to which alternative yields the most benefits or effectiveness.

(3) Unequal Benefits and Unequal Costs - There is no all-purpose criterion for ranking alternatives in cases where both benefits and costs are unequal. If the benefits

(3) When the independent parametric cost estimate differs from the program manager's current estimate, the latter estimate will be used for economic analysis/program evaluations. Once a program estimate is established as a baseline, a program/project manager will manage his program within that limitation.

(4) The program manager's current estimate will be an assessment of the ultimate cost expected for a program/project including undefinitized contingencies. As such, the program manager's current estimate should be relatively stable over long periods of time and not change with small incremental changes to the approved program, funding changes, or financial fluctuations. To the extent possible, schedules and funding should be structured to accommodate program uncertainties and unforeseen problems.

b. Special degrees of risk/uncertainty associated with a particular program/project, may be pointed out quantitatively in an analysis and used for program review purposes. Probability estimates can be developed by testing the sensitivity of key variables on estimated costs and performance. The probability that each of the possible cost or output estimates may be realized should be discussed narratively when there is no basis for a quantitative estimate.

c. Estimates will be expressed in terms of performance thresholds, goals, or ranges. Program/project estimates will include the limits within which ultimate program cost and technical performance is expected to fall.

8. Constraints. Limitations on the proposed action will be identified, e.g., limitations of manpower, facilities, or existing organizational, institutional, procedural or other factors and identification of any special geographical implications.

9. Sensitivity Analysis. The analysis should include a test of the sensitivity of the results of any factor, including possible side effects, which may significantly impact on the problem under study.

C. Documentation. The method of documentation used to record and summarize cost and output information will usually vary from one study to another. However, guidelines for documenting the required information are provided in this enclosure to insure completeness and consistency.

1. Formats A, A-1, and B may be useful for organizing the results of an economic analysis or program evaluation, but are not intended as required forms. Formats A and A-1 focus on the same

3. Stipulate the number of personnel involved in doing the analysis, a brief explanation of the source for cost and output estimates, any extraordinary expenditure, any major overhauls or refurbishments required, and an explanation of any other significant considerations which may impact on the decision.

4. Identify the principal parties responsible for preparing and approving the analysis and the date it was made.

D. Examples of activities normally requiring an economic analysis are listed in Attachment 5 to this enclosure.

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(Att 1 to Encl 2)

SUMMARY OF COSTS FOR ECONOMIC ANALYSIS/
PROGRAM EVALUATION STUDIES
FORMAT A

13. Source/Derivation of Cost Estimates: (Use as much space as required)

a. Non-Recurring Costs:

1.) Research & Development:

2.) Investment:

b. Recurring Cost:

c. Net Terminal Value:

d. Other Considerations:

14. Name & Title of Principal Action Officer	Date

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(Att. 2 to Encl 2)

**SUMMARY OF COSTS FOR ECONOMIC ANALYSIS/
PROGRAM EVALUATION STUDIES
FORMAT A-1**

13. Present Value of New Investment:

    a. Land and Buildings _____
    b. Equipment _____
    c. Other (identify nature) _____
    d. Working Capital (Change-plus or minus) _____

14. Total Present Value of New Investment (i.e., Funding Requirements). _____

15. Plus: Value of existing assets to be employed on the project. _____

16. Less: Value of existing assets replaced. _____

17. Less: Terminal Value of new investment. _____

18. Total New Present Value of Investment. $_____

19. Present Value of Cost Savings from Operations (Col. 11). _____

20. Plus: Present Value of the Cost of Refurbishment or Modifications Eliminated. _____

21. Total Present Value of Savings. $_____

22. Savings/Investment Ratio (Line 21 divided by Line 18). _____

23. Rate of Return on Investment. _____

SUMMARY OF OUTPUTS FOR ECONOMIC ANALYSIS OR PROGRAM EVALUATION STUDIES
FORMAT B

1. **Submitting DoD Component:** _____

2. **Date of Submission:** _____

3. **Project Title:** _____

4. **Description of Project Objective:** _____

5. **Alternative:** _____ 6. **Economic Life:** _____

7. **Outputs:**

   a. Expected Benefits, Output, and Indicators of Effectiveness: (Describe and justify)

   b. Non-Quantifiable Benefits: (Describe and justify)

   c. Present Value of Revenues: (Describe and justify)

Program/Project Year Discount Factors

Project Year	Table A[1/] PRESENT VALUE OF $1 (Single Amount - To be used when cash-flows accrue in different amounts each year). 10%	Table B[2/] PRESENT VALUE OF $1 (Cumulative Uniform Series - To be used when cash-flows accrue in the same amount each year). 10%
1	0.954	0.954
2	0.867	1.821
3	0.788	2.609
4	0.717	3.326
5	0.652	3.977
6	0.592	4.570
7	0.538	5.108
8	0.489	5.597
9	0.445	6.042
10	0.405	6.447
11	0.368	6.815
12	0.334	7.149
13	0.304	7.453
14	0.276	7.729
15	0.251	7.980
16	0.228	8.209
17	0.208	8.416
18	0.189	8.605
19	0.172	8.777
20	0.156	8.933
21	0.142	9.074
22	0.129	9.203
23	0.117	9.320
24	0.107	9.427
25	0.097	9.524

1/ Factors are based on continuous compounding of interest at the stated effective rate per annum, assuming uniform cash flows throughout stated one-year periods. These factors are equivalent to an arithmetic average of beginning and end of the year compound amount factors found in standard present value tables.

2/ Table B factors represent the cumulative sum of the factors in Table A at the end of any given year.

falling under the exceptions for comparative cost studies stated in reference (j) will be performed in accordance with DoDI 7041.3.

5. Modernization projects to mechanize, prevent obsolescence, improve work flow and layout, or increase capacity, which lead to a reduction in costs or an increase in mission performance.

6. Repair or replacement for weapon systems, and for equipment machine tools and other industrial production equipment as prescribed by DoDI 4215.14 and DoDI 4275.5, references (n) and (o).

7. Lease vs. buy, e.g., lease or purchase general purpose real property such as office buildings, warehouses, and associated land (reference (i)).

8. Acquisition of services and utilization of manpower.

9. Consolidation of facilities, such as warehouses, maintenance and storage depots, and repair activities to decrease cost for any reason or to enhance mission effectiveness.

10. Refurbishment to reduce operating and/or maintenance costs.

11. Material and supply handling projects to increase efficiency or capacity.

12. Development of automated data systems and selection and acquisition of data processing resources. References (p) and (q) emphasize the need for economic analysis.

13. Research and development projects to increase effectiveness or promote efficiency in military and other programs, and increases in research and development funding to provide for new maintenance concepts and procedures intended to reduce total operations and maintenance costs or to extend equipment/systems operating life cycles.

E. Cost-Effectiveness Analysis - (See Benefit-Cost Analysis).

F. Discount Rate - The interest rate used to discount or calculate future costs and benefits so as to arrive at their present values (see also Present Value).

G. Discounting - (See Present Value).

H. Economic Analysis - (See para. A. of Section IV. of the basic Instruction).

I. Economic Life - The period of time over which the benefits to be gained from a project may reasonably be expected to accrue to the Department of Defense. (Although economic life is not necessarily the same as physical life or technological life, it is significantly affected by both the obsolescence of the investment itself and the purpose it is designed to achieve.) The economic life of a project begins in the year in which it starts producing benefits. Thus, it is possible that investments may occur several years prior to the time the project starts producing benefits.

J. Effectiveness - The performance or output received from an approach or program. (See Output and Output Measures.)

K. Equipment - Machinery, furniture, vehicles, machines used or capable of use in the manufacture of supplies or in performance of services or for any administrative or general plant purposes.

L. Expected Annual Cost - The expected annual dollar value (in constant dollars) of resources, goods, and services required to establish and carry out a program or project.

M. Historical Cost - The cost of any objective based upon actual dollar or equivalent outlay ascertained after the fact. May use any one of a number of methods of cost determination.

N. Investment Costs - (See also Enclosure 3, para. B.4.a.(2), page 3, for definition of investment costs).

2. Present Value Cost - Each year's expected yearly cost multiplied by its discount factor and then summed over all years of the planning period.

3. Present Value Net Benefit - The difference between present value benefit and present value cost.

S. Program Evaluation - (See Section IV. para. C. of the basic Instruction).

T. Real Property - Land and rights therein, utility generation plants and distribution systems, building, structures, and improvements thereto.

U. Recurring Costs - Expenses for personnel, materiel consumed in use, operating, overhead, support services, and other items incurred on an annual basis.

V. Residual Value - The computed value of existing facilities, and other assets or facilities and other assets not in being, at any point in time.

W. Sunk Cost - A cost which is irrevocably committed to a project; such costs have no bearing on the results of comparative cost studies.

X. Technological Life - The estimated number of years before technology will make the existing or proposed equipment or facilities obsolete.

Y. Terminal Value - The expected value of either existing facilities, and other assets or facilities and other assets not yet in being, at the end of their useful life.

Z. Uniform Annual Cost - The amount of money which if budgeted in equal yearly installments would pay for the project. The total present value of these installments would be equal to the total present value computed from the estimated life-cycle costs.

APPENDIX B: [Ref. 75]

VHA IF DRAWING BAQ AT THE WITH DEPENDENT RATE

Grade	0.20
O-6	93.72
O-5	85.26
O-4	76.08
O-3	68.40
O-2	60.90
O-1	48.90
W-4	73.32
W-3	66.78
W-2	59.94
W-1	55.08
E-9	64.50
E-8	59.58
E-7	55.44
E-6	51.00
E-5	46.86
E-4	41.22
E-3	35.94
E-2	35.94
E-1	35.94

APPENDIX C: [Ref. 76]

VHA IF DRAWING BAQ AT THE WITHOUT DEPENDENT RATE

Grade	0.20
O-6	76.80
O-5	70.80
O-4	63.00
O-3	55.44
O-2	48.12
O-1	37.56
W-4	60.72
W-3	64.16
W-2	47.10
W-1	42.54
E-9	45.84
E-8	42.24
E-7	35.94
E-6	32.64
E-5	31.38
E-4	27.66
E-3	24.72
E-2	21.84
E-1	20.64

APPENDIX D

NOTIONAL AIRCRAFT CARRIER SHIP'S COMPANY MANNING LEVEL

Officer	Number
06	2
05	35
04	45
03	84
02	27
01	30
W4	8
W3	10
W2	25
W1	0
TOTAL	266

Enlisted	Number
E9	22
E8	23
E7	94
E6	250
E5	435
E4	653
E3, E2, E1	1367
TOTAL	2844
Total Ship's Company Personnel:	3010

APPENDIX E

NOTIONAL AIR WING MANNING LEVEL

Officer	Number
05	20
04	46
03	91
02	165
01	18
W4	0
W3	0
W2	16
W1	0
TOTAL	356

Enlisted	Number
E9	18
E8	42
E7	61
E6	235
E5	476
E4	440
E3, E2, E1	772
TOTAL	2044
Total Air Wing Personnel:	2400

APPENDIX F

COMBINED NOTIONAL AIR WING AND SHIP'S COMPANY PERSONNEL

Officer	Number
06	2
05	55
04	91
03	175
02	192
01	48
W4	8
W3	10
W2	41
W1	0
TOTAL	622

Enlisted	Number
E9	40
E8	65
E7	155
E6	435
E5	911
E4	1093
E3, E2, E1	2139
TOTAL	4888
TOTAL PERSONNEL:	5410

APPENDIX G

NOTIONAL AIR WING AND AIRCRAFT CARRIER PERSONNEL MARITAL AND DEPENDENT STATUS [Ref. 77]

Paygrade	% Married	Number Married	Dependents Per Married Personnel	Number Dependents
06	98.0	1.96	2.8	5.49
05	96.7	53.19	2.8	148.93
04	94.2	85.72	2.8	240;02
03	81.4	142.28	2.8	398.38
02	56.1	107.71	2.8	301.59
01	41.7	20.02	2.8	56.06
W4	95.4	7.63	2.8	21.36
W3	95.4	9.54	2.8	26.71
W2	95.4	31.11	2.8	87.11
TOTAL FOR OFFICERS:		459.16		1285.65
E9	96.2	38.48	2.4	92.35
E8	96.3	62.60	2.4	150.24
E7	94.1	145.86	2.4	350.06
E6	87.6	424.86	2.4	1019.66
E5	57.7	525.65	2.4	1261.56
E4 Over 4	55.4	82.02	2.4	196.85
Under 4	25.9	244.48	2.4	586.75
E3	16.9	230.53	2.4	553.27
E2	7.7	47.82	2.4	114.77
E1	4.6	7.08	2.4	17.00
TOTAL FOR ENLISTED:		1809.38		4342.51
TOTAL FOR BOTH:		2268.54		5628.16
TOTAL ELIGIBLE FOR FSA, TYPE II: 1738.63				

APPENDIX H

NUMBER OF PERSONNEL NOT TAKING DEPENDENTS OVERSEAS

Paygrade	Number Married	% Not Taking Dependents Overseas [Ref 78]	# Not Taking Dependents Overseas
O6	1.96	37.86	0.74
O5	53.19	37.86	20.14
O4	85.72	37.86	32.45
O3	142.28	37.86	53.87
O2	107.71	37.86	40.78
O1	20.02	37.86	7.58
W4	7.63	37.86	2.89
W3	9.54	37.86	3.61
W2	31.11	37.86	11.78
W1	0.0	37.86	0.0
E9	38.48	63.37	26.31
E8	62.60	68.37	42.80
E7	145.86	68.37	99.72
E6	424.86	68.37	290.48
E5	525.65	68.37	359.39
E4	326.50	68.37	223.23
E3	16.9	68.37	11.55
E2	7.7	68.37	5.26
E1	4.6	68.37	3.15

APPENDIX I

VHA COST OF PERSONNEL NOT TAKING DEPENDENTS OVERSEAS

Paygrade	Number*	Occupancy Rates of Non-Government Quarters 25%	50%	75%	100%
06	0.74	26.08	52.16	78.24	104.31
05	20.14	643.85	1287.71	1931.56	2575.41
04	32.45	925.90	1851.80	2777.70	3703.60
03	142.28	921.13	1842.26	2763.39	3684.52
02	40.78	620.86	1241.72	1862.58	2483.44
01	7.58	92.66	185.32	277.98	370.64
W4	2.89	79.43	158.85	238.28	317.70
W3	3.61	60.30	120.60	180.90	241.20
W2	11.78	176.50	353.00	529.50	705.99
W1	0.00	0.00	0.00	0.00	0.00
OFFICER TOTAL:		3546.71	7093.42	10640.13	14186.81
E9	26.31	742.37	1484.74	2227.11	2969.47
E8	42.80	1115.68	2231.36	3347.04	4462.72
E7	99.72	2418.82	4837.64	7256.46	9675.27
E6	290.48	5555.37	11110.74	16666.11	22221.47
E5	359.39	6312.63	12625.26	18937.89	25250.52
E4	223.23	3451.66	6903.33	10354.32	13806.65
E3	11.55	155.73	311.45	467.18	622.90
E2	5.26	70.95	141.91	212.86	283.81
E1	3.15	42.46	84.91	127.37	169.82
ENLISTED TOTAL:		19865.67	39731.34	59596.34	79462.63
TOTAL OF BOTH:		23412.38	46824.76	70236.47	93649.44

* Number of Personnel Not Taking Dependents Overseas Calculated in Appendix H.

APPENDIX J

NUMBER OF DEPENDENTS GOING OVERSEAS [Ref. 79]

Paygrade	Number Married	% Taking Dependents Overseas	Dependents per Family	Total Dependents
O6	1.96	62.14	2.73	3.32
O5	53.19	62.14	2.73	90.23
O4	85.72	62.14	2.73	145.38
O3	142.28	62.14	2.73	241.31
O2	107.71	62.14	2.73	182.68
O1	20.02	62.14	2.73	33.95
W4	7.63	62.14	2.73	12.94
W3	9.54	62.14	2.73	16.18
W2	31.11	62.14	2.73	52.76
W1	0.00	62.14	2.73	0.00
TOTAL FOR OFFICERS:				778.75
E9	38.48	31.63	2.68	32.62
E8	62.60	31.63	2.68	53.08
E7	145.36	31.63	2.68	123.69
E6	424.86	31.63	2.68	360.28
E5	525.65	31.63	2.68	445.75
E4	326.50	31.63	2.68	276.87
E3	16.90	31.63	2.68	14.33
E2	7.70	31.63	2.68	6.53
E1	4.60	31.63	2.68	3.90
TOTAL FOR ENLISTED:				1317.05
TOTAL FOR BOTH:				2095.80

APPENDIX K

NUMBER OF PERSONNEL SHIPPING POV'S OVERSEAS (Nv)

Number of Personnel E5 and Above*		2178
Number of Personnel E4 and Below, with Dependents Overseas**		243
	TOTAL:	2421

* From Appendix F

**From Appendix G

APPENDIX L

COST OF TRANSPORTING POV'S OVERSEAS

Cost Per Cubic Foot [Ref. 80]	$ 2.24
Number of Cubic Feet Per Measurement Ton (MT)	40.00
Average MT's Per each POV [Ref. 81]	12.00

$2.24 x 40 x 12 = $1,075.20

Number of POV's Being Shipped Overseas (Nv) 2421

2421 x $1075.20 = $2,603,059.20

APPENDIX H

COST OF TRANSPORTING POV's TO DEPARTURE TERMINAL FOR OVERSEAS SHIPMENT

Flat Rate Per Diem (Cpd) [Ref. 82]	$50.00
Allowance Per Mile (Cpm) [Ref. 83]	$ 0.13
Number of Miles from Norfolk, Virginia to Bayonne, New Jersey (Nvm)	350

Cpd + (Cpm x Nvm)

$50.00 + ($0.13 x 350) + $95.50 Per POV

Number of POV's Being Shipped Overseas*	2421

2421 x $95.50 = $231,205.50

*From Appendix K

APPENDIX N

WEIGHT SHIPPED UPON SHIFT OF HOMEPORT

Paygrade	#Married	% Taking Dependents	Max # Pounds [Ref. 84]	Total
06	1.96	62.14	13,500	16,442.2
05	53.19	62.14	13,000	428,711.4
04	85.72	62.14	12,000	637,756.8
03	142.28	62.14	11,000	970,349.6
02	107.71	62.14	10,000	667.802.0
01	20.02	62.14	9,500	117,917.8
W4	7.63	62.14	12,000	56,767.2
W3	9.54	62.14	11,000	65,062.8
W2	31.11	62.14	10,000	192,882.0
W1	.00	62.14	9,500	0.0
E9	38.48	31.63	9,500	116,979.2
E8	62.60	31.63	9,000	180,288.0
E7	145.86	31.63	8,500	396.739.2
E6	424.86	31.63	8,000	1,087,641.6
E5	525.65	31.63	7,000	1,177,456.0
E4	326.50	31.63	7,000	731,360.0
E3	16.90	31.63	1,500	8,112.0
E2	7.70	31.63	1,500	3,696.0
E1	4.60	31.63	1,500	2,208.0
			TOTAL:	6,858,171.8

APPENDIX O

SQUARE FOOT CONSTRUCTION COSTS [Ref. 85]

Facilities	Cost Per Square Foot
Academic	$ 62.00
Chapels	98.00
Commissaries	55.00
Exchange Stores	65.00
Hangers, General Purpose, or Maintenance	65.00
Dispensaries	85.00
Dental Clinics	128.00

APPENDIX P

AIRCRAFT FACILITIES LOADING AND COST [Ref. 86]

Notional Number of Aircraft: 90

Number of Aircraft per Hanger Facility:* 15

	25%	50%	75%	100%
Number of Aircraft	23	45	68	90
SF for Hanger	30,618	61,235	91,853	119,808
SF for Crew & Equip.	13,035	26,070	39,105	52,140
SF for Admin Space	12,960	25,920	38,380	51,840
Total SF Required	56,613	113,225	169,338	223,788
Cost per SF	$65	$65	$65	$65
OAF**	1.3	1.3	1.3	1.3
Additional Cost	$4,783,799	$9,567,513	$14,351,311	$18,910,086

*Each facility includes hanger space, crew and equipment space, and administrative space.
** Overseas Adjustment Factor

APPENDIX Q

MEDICAL LOADING AND COST [Ref. 87]

Outpatient Care

	25%	50%	75%	100%
Number of Dependents	524	1,048	1,572	2,096
Visit Rate	5.0	5.0	5.0	5.0
Increase in Outpatient Workload	2,620	5,240	7.860	10.480
SF Required*	2,382	5,764	8,646	11,317

Inpatient Treatment

	25%	50%	75%	100%
Number of Dependents	524	1,048	1,572	2,096
Bed Requirement Factor	.004	.004	.004	.004
Bed Requirement	2,096	4.192	6.288	8.384
SF Required	4,316	8,631	12,947	17,263
Total SF	7,198	14,395	21,593	28,680
Cost per SF	$85	$85	$85	$85
OAF **	1.3	1.3	1.3	1.3
Additional Cost	$795,379	$1,590,648	$2,386,027	$3,158,090

*SF = Square Feet
** = Overseas Adjustment Factor

APPENDIX R

DENTAL CLINIC LOADING AND COST [Ref. 88]

Dental Operating Rooms (DOR)

	25%	50%	75%	100%
Number of Dependents	524	1,048	1,572	2,096
Dental Officer Factor	0.75	1.50	2.25	3.00
DOR Factor	2.0	2.0	2.0	2.0
Number of DOR's	1.5	3.0	4.5	6.0
SF* for DOR's	2,175	3,400	4,270	6,875

Oral Hygiene Treatment Room (HTR)

	25%	50%	75%	100%
Number of Dependents	524	1,048	1,572	2,096
Number of OHTR's Required	0.35	0.70	1.05	1.40
Nearest Whole Number	0	1	1	1
SF for OHTR	0	1,450	1,450	1,450
Total SF	2,175	4,850	5,720	8,325
Cost per SF	$128	$128	$128	$128
OAF**	1.3	1.3	1.3	1.3
Additional Cost	$361,920	$807,040	$951,808	$1,385,280

*SF = Square Feet
**OAF = Overseas Adjustment Factor

APPENDIX S

COMMISSARY LOADING AND COST [Ref. 89]

Number of Families	(459.16)(62.14%)		(1309.38)(31.63%)	
	285.32		572.30	
TOTAL	857.62 or 358			

	25%	50%	75%	100%
Number of Families	215	429	644	358
Ave. Monthly Purchases per Family	$240	$240	$240	$240
Additional Purchases	$51,600	$102,960	$154,560	$205,920

Producers Price Index (PPI) for 1 May 1981: 251.0

PPI in Navfac P-80 Based on 1 July 1970: 113.5

Sales are adjusted downward by dividing the current PPI by the PPI used in Navfac P-80, and then dividing that factor into the estimated monthly sales volume.

	25%	50%	75%	100%
PPI Adjustment Factor	2.21	2.21	2.21	2.21
Adjusted Sales	$23,248	$46,588	¢69,937	$93,176
SF* Required	6,000	9,000	15,750	20,250
Cost per SF	$55	$55	$55	$55
OAF**	1.3	1.3	1.3	1.3
Additional Cost	$429,000	$643,500	$1,126.125	$1,447,875

*SF = Square Feet
**OAF = Overseas Adjustment Factor

APPENDIX T

EXCHANGE LOADING AND COST [Ref. 90]

Major Customers (Officers, Married Enlisted, and Dependents)

Number of Officers	622
Number of Married Enlisted	572
Number of Dependents	2,096
TOTAL:	3,290

	25%	50%	75%	100%
Major Customers	823	1,645	2,468	3,290
Point Values*	13	25	35	45

Single Enlisted Military Customers

Number of Enlisted	4,888
Less Married Enlisted	1,809
Number of Single Enlisted	3,079
Plus Married Enlisted whose Dependents are in CONUS	1,237
TOTAL:	4,316

	25%	50%	75%	100%
Single Customers	1,079	2,158	3,237	4,316
Point Values	15	21	26	31
Total Point Value	28	46	61	76
Number of SF**	9,000	13,800	15,800	17,700
Cost per SF	$65	$65	$65	$65
OAF***	1.3	1.3	1.3	1.3
Additional Cost	$760,500	$1,166,100	$1,335,100	$1,495,650

*Environmental Adjustment Factor (EAF) is Equal to 1.00
**SF = Square Feet
***OAF = Overseas Adjustment Factor

APPENDIX U

DEPENDENT SCHOOL LOADING AND COST [Ref. 91]

Grade School (1-6)*				
	25%	50%	75%	100%
Number of Students	113	223	336	446
Number of SF**	12,300	25,000	40,700	47,400
High School (7-12)				
Number of Students	57	113	170	223
Number of SF	26,800	26,800	30,900	34,900
TOTAL SF***	39,100	51,800	71,600	82,300
COST PER SF	$62	$62	$62	$62
OAF	1.3	1.3	1.3	1.3
ADDITIONAL COST	$3,151,460	$4,175,080	$5,770,960	$6,633,380

*Includes space for kindergarten.

**SF = Square Feet

***Includes space for general purpose classrooms, special classrooms, gymnasium, library, and multi-purpose kitchen

APPENDIX V

CHAPEL LOADING AND COST [Ref. 92]

Number of Military Married Personnel (with dependents overseas)		858
Number of Primary Dependents over age 6	858 x 2.3	1973
Total Military Personnel		5410
Population Count		7383

	25%	50%	75%	100%
Population Count	1846	3692	5538	7383
Number of Chapel Seats	300	600	900	1200
EAF	0.40	0.40	0.40	0.40
Adjusted Number of Chapel Seats	120	240	360	480
SF Required	3,900	7,800	10,260	12,240
Cost per SF	$98	$98	$98	$98
OAF	1.3	1.3	1.3	1.3
Additional Cost	$382,200	$764,400	$1,005,480	$1,199,520

Environmental Adjustment Factor (EAF)--Assumes four major denominations with less than 80 percent residing on the installation or within a distance of two miles of the installation, but more than 40 percent residing within a distance of five miles of the installation.

APPENDIX W

NUMBER OF FAMILIES GOING OVERSEAS

Number of Married Officers	459.16
Percentage Taking Families Overseas [Ref. 93]	62.14
Number of Officer Families Going Overseas	285.32
Number of Married Enlisted	1809.38
Percentage Taking Families Overseas [Ref. 93]	31.63
Number of Enlisted Families Going Overseas	572.30
Total Number of Families Going Overseas	857.62

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